DOCUMENT RESUME

ED 397 324 CE 072 209

| | |
|---|---|
| TITLE | Mississippi Curriculum Framework for Metal Trades (Program CIP: 48.0590--Metal Trades). Secondary Programs. |
| INSTITUTION | Mississippi Research and Curriculum Unit for Vocational and Technical Education, State College. |
| SPONS AGENCY | Mississippi State Dept. of Education, Jackson. Office of Vocational and Technical Education. |
| PUB DATE | 30 Jul 96 |
| NOTE | 86p.; For related documents, see CE 072 162-231. |
| PUB TYPE | Guides - Classroom Use - Teaching Guides (For Teacher) (052) |
| EDRS PRICE | MF01/PC04 Plus Postage. |
| DESCRIPTORS | Academic Education; Behavioral Objectives; Classroom Techniques; Competence; *Competency Based Education; Core Curriculum; Educational Equipment; Employment Qualifications; Leadership; Machine Repairers; *Machine Tool Operators; *Machine Tools; *Metal Working; Secondary Education; State Curriculum Guides; Statewide Planning; Student Evaluation; *Welding |
| IDENTIFIERS | Mississippi |

ABSTRACT

This document, which reflects Mississippi's statutory requirement that instructional programs be based on core curricula and performance-based assessment, contains outlines of the instructional units required in local instructional management plans and daily lesson plans for metal trades I, IIA (advanced welding), and IIB (advanced machine shop). Presented first are a program description and course outlines. Section I contains curriculum frameworks for the courses, and section II contains outlines of the instructional units required in each course. Units in metal trades I are as follows: orientation and safety; measurement, inspections, and blueprints; bench work; power saws and drilling machines; basic oxyacetylene welding, cutting, and brazing; basic shielded arc metal welding; basic machine shop; and basic sheet metal repair. Advanced welding units in course IIA include the following: shielded metal arc welding, gas metal arc welding, flux core arc welding, gas tungsten arc welding, and plasma arc cutting. Units in advanced machine shop course IIB are as follows: lathe operations, milling operations, and grinding operations. Each unit includes suggested time on tasks, competencies and objectives, teaching strategies, assessment strategies, and resources. Recommended tools and equipment are listed in section III. Appended are lists of related academic topics and workplace skills for the 21st century and student competency profiles for both courses. (YLB)

**********
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
**********

ED 397 324

# Mississippi Curriculum Framework for Metal Trades

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

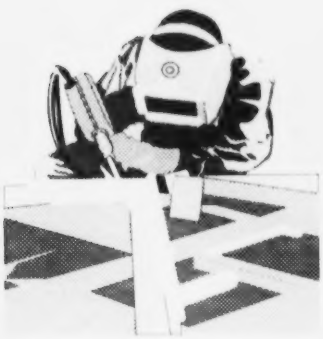
☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

[signature]

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."



CE 072 209

***Secondary***
***Vocational and Technical Education***
***1996***

BEST COPY AVAILABLE

July 30, 1996

# MISSISSIPPI

# CURRICULUM FRAMEWORK

# FOR

# METAL TRADES

# (PROGRAM CIP: 48.0590 - Metal Trades)

July 30, 1996

Direct inquiries to:

Program Coordinator
Trade and Technical Education
Office of Vocational and Technical Education
Mississippi Department of Education
P. O. Box 771
Jackson, MS 39205
(601) 359-3940

For copies of this publication, contact:

Research and Curriculum Unit
Mississippi State University
P. O. Drawer DX
Mississippi State, MS 39762
(601) 325-2510

Published by the:

Office of Vocational and Technical Education
Mississippi Department of Education
Jackson, Mississippi

Research and Curriculum Unit for Vocational and Technical Education
College of Education
Mississippi State University
Mississippi State, Mississippi

1996

Mississippi State University does not discriminate on the basis of race, color, religion, national origin, sex, age, handicap/disability, or veteran status.

# FOREWORD

The courses in this document reflect the following statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended:

> The State Department of Education shall provide an instructional program and establish guidelines and procedures for managing such programs in the public schools as part of the State Program of Educational Accountability and Assessment of Performance. . .
>
> The department shall provide that such program or guidelines . . . are enforced through the performance-based accreditation system.
>
> The local school board must adopt the objectives that will form the core curriculum that will be systematically delivered throughout the district.
>
> Standards for student performance must be established for each core objective in the local program and those standards establish the district's definition of mastery for each objective.
>
> There shall be an annual review of student performance in the instructional program against locally established standards.

Each secondary vocational-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - The number of days of instruction that should be required to teach the competencies and objectives of the unit. For secondary occupational programs, a "day" represents a two-period block of instruction.
- Competencies and Suggested Objectives
  - A **Competency** represents a general concept of performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to master all competencies in the curriculum framework in order to satisfactorily complete the course.
  - The **Suggested Objectives** represent the enabling and supporting knowledge and performances that will indicate mastery of the competency.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each suggested objective. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.

- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include classroom discussions, laboratory exercises, and student assignments. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.
- Suggested Resources - This section indicates some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

The following guidelines were used in developing the curriculum framework in this document and should be considered in developing local instructional management plans and daily lesson plans:

- The content of the courses in this document reflects approximately 75 percent of the time allocated to each course. For a one-year course, this means that the content of the existing units of instruction should represent approximately 135 days of instruction. The remaining 25 percent of each course should be developed at the local district level and may reflect:
  - Additional units of instruction within the course related to topics not found in the state framework.
  - Activities which develop a higher level of mastery on the existing competencies and suggested objectives.
  - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed/revised.
  - Activities which implement components of the Mississippi Tech Prep Initiative, including integration of academic and vocational-technical skills and coursework, school-to-career transition activities, and articulation of secondary and postsecondary vocational-technical programs.
  - Individualized learning activities, including work site learning activities, to better prepare individuals in the courses for their chosen occupational area.
- Sequencing of the units of instruction within a course is left to the discretion of the local district. Naturally, foundation units related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other units related to specific skill areas in the course, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors.

## ACKNOWLEDGEMENTS

### Instructors

Billy Beavers, Forest-Scott County Vocational Center, Forest
Hubert Owens, Oxford-Lafayette B & I
Leo Parker, Winston-Louisville Vocational Center, Louisville
Charles B. Riley, Yazoo City Vocational Center,
Donald Taylor, Itawamba Community College, Tupelo
Charles H. Wooley, Miss. Delta Community College

### Team Leader

Rick Crider, Research and Curriculum Unit

### OVTE Staff

John White, Program Coordinator
Trade, Industrial, and Related Technology

### Reviewers

Practitioners:
Gary D. Brown
John A. Gaddis
James V. Jones
Sara McKinney
Terry Moore
John D. Rickman
Danny J. Robinson
Tommy Smallwood
Dennis Wood

Educators:
Dalton Anthony
Billy Beavers
C. A. Doty
A.E. Eichelberger
Horace Godbold III
Charlie G. Hill
Barry L. Hobson
Eldridge R. Lowe
J. J. Lucas
Herbert Owens
Charles B. Ricky
Jeffrey Saksa
John N. Sample
Larry Summers
James Treloar, Jr.
John Burt Wooten

July 30, 1996

Technical Committee for Industrial Curricula

Sam Cobbins
Larry Crimm
Dearld Dear
John DeVoe
Grady Edwards
Don Gillespie
James Ivy
Ken Riley
Lin Rodgers
Joseph Simon
L.W. Smith
Fred Strohm
Jack Wynne

# TABLE OF CONTENTS

Page

FOREWORD . . . . . iii

ACKNOWLEDGEMENTS . . . . . v

PROGRAM DESCRIPTION . . . . . 1

COURSE OUTLINE . . . . . 2

SECTION I: CURRICULUM FRAMEWORK FOR METAL TRADES . . . . . 3

Metal Trades I . . . . . 5
Metal Trades II (Advanced Welding Option) . . . . . 12
Metal Trades II (Advanced Machine Shop Option) . . . . . 14

SECTION II: CURRICULUM GUIDE FOR METAL TRADES . . . . . 17

Metal Trades I . . . . . 19
Unit 1: Orientation and Safety . . . . . 21
Unit 2: Measurement, Inspections, and Blueprints . . . . . 24
Unit 3: Bench Work . . . . . 27
Unit 4: Power Saws and Drilling Machines . . . . . 29
Unit 5: Basic Oxyacetylene Welding, Cutting, and Brazing . . . . . 32
Unit 6: Basic Shielded Arc Metal Welding . . . . . 34
Unit 7: Basic Machine Shop . . . . . 36
Unit 8: Basic Sheet Metal Repair . . . . . 39

Metal Trades II (Advanced Welding Option) . . . . . 41
Unit A1: Shielded Metal Arc Welding (SMAW) . . . . . 43
Unit A2: Gas Metal Arc Welding (GMAW) . . . . . 44
Unit A3: Flux Core Arc Welding (FCAW) (Optional) . . . . . 46
Unit A4: Gas Tungsten Arc Welding (GTAW) (Optional) . . . . . 48
Unit A5: Plasma Arc Cutting (PAC) . . . . . 50

Metal Trades II (Advanced Machine Shop Option) . . . . . 53
Unit B1: Lathe Operations . . . . . 55
Unit B2: Milling Operations . . . . . 57
Unit B3: Grinding Operations . . . . . 60

SECTION III: RECOMMENDED TOOLS AND EQUIPMENT . . . . . 63

APPENDIX A: RELATED ACADEMIC TOPICS . . . . . A-1

APPENDIX B: WORKPLACE SKILLS . . . . . B-1

APPENDIX C: STUDENT COMPETENCY PROFILE . . . . . C-1

# PROGRAM DESCRIPTION

## METAL TRADES

(Program CIP: 48.0590 - Metal Trades)

The Metal Trades (secondary) program is designed as a cluster program for preparation to enter the metal working trades and is offered in grades 11 and 12 in Mississippi high schools and area vocational schools. Metal Trades I includes an introduction to the basic metal working processes. Metal Trades II requires that students choose one of two options (Advanced Welding Option or Advanced Machine Shop Option). The purpose of the course is to prepare students to continue study in a postsecondary metal trades program or to begin work at the entry level in metal working occupations.

National Standards Developed by American Welding Society (AWS)

The welding competencies required in this curriculum were developed to coincide with the Specification for Qualification and Certification for Entry Level Welders (AWS QC 10-95), developed by the American Welding Society and funded by the U.S. Department of Education under Grant V.244 B 3006. The contributions of this resource are hereby acknowledged.

The American Welding Society provides a series of reference materials to support this curriculum. For additional information on AWS Educational membership contact: American Welding Society, AWS Education Department, 550 N.W. LeJeune Road, Miami, FL 33161. Phone: (800) 443-WELD. FAX: (305) 443-7559.

# COURSE OUTLINE

## METAL TRADES I

| Unit No. | Unit Name | Days |
|---|---|---|
| Unit 1 | Orientation and Safety | 5 |
| Unit 2 | Measurement, Inspections, and Blueprints | 15 |
| Unit 3 | Bench Work | 15 |
| Unit 4 | Power Saws and Drilling Machines | 5 |
| Unit 5 | Basic Oxyacetylene Welding, Cutting, and Brazing | 15 |
| Unit 6 | Basic Shielded Arc Metal Welding | 25 |
| Unit 7 | Basic Machine Shop | 40 |
| Unit 8 | Basic Sheet Metal | 15 |

## METAL TRADES II
(Advanced Welding Option)

| Unit No. | Unit Name | Days |
|---|---|---|
| Unit A1 | Shielded Metal Arc Welding (SMAW) | 50 |
| Unit A2 | Gas Metal Arc Welding (GMAW) | 50 |
| Unit A3 | Flux Core Arc Welding (FCAW) (Optional) | 15 |
| Unit A4 | Gas Tungsten Arc Welding (GTAW) (Optional) | 18 |
| Unit 5A | Plasma Arc Cutting (PAC) | 2 |

## METAL TRADES II
(Advanced Machine Shop Option)

| Unit No. | Unit Name | Days |
|---|---|---|
| Unit B1 | Lathe Operations | 85 |
| Unit B2 | Milling Operations | 35 |
| Unit B3 | Grinding Operations | 15 |

# SECTION I:

# CURRICULUM FRAMEWORK

# FOR

# METAL TRADES

# CURRICULUM FRAMEWORK

**Course Name:** Metal Trades I

**Course CIP Code:** 48.0590

**Course Description:** The Secondary Metal Trades program is designed as a cluster program for preparation to enter the metal working trades and is offered in grades 11 and 12 in Mississippi high schools and area vocational schools. Metal Trades I includes an introduction to the basic metal working processes. Units include Orientation and Safety; Measurement, Inspections, and Blueprints; Bench Work; Power Saws and Drilling Machines; Basic Oxyacetylene Welding, Cutting, and Brazing; Basic Shielded Arc Metal Welding; Basic Machine Shop; and Basic Sheet Metal. (2-2½ Carnegie Units, depending upon time spent in the course)

**Competencies and Suggested Objectives:**

1. Demonstrate the student school handbook and classroom policies.
   a. Identify policies found in the school handbook.
   b. Identify classroom rules and policies.
   *Related Academic Topics (See Appendix A): C1, C2, C3*
   *Workplace Skills (See Appendix B): WP2, WP6*
2. Review occupational and leadership opportunities in metal trades.
   a. Investigate occupational opportunities in the local area.
   b. Update the student's Career/Educational Plan.
   c. Describe leadership opportunities available from student youth organizations in the school and community, including VICA.
   *Related Academic Topics (See Appendix A): C1, C4, C6*
   *Workplace Skills (See Appendix B): WP2, WP3, WP6*
3. Demonstrate safety procedures used in metal trades.
   a. Apply safety rules for personal and general shop safety including eye (State Eye Safety Law provisions), ear, and body protection; general rules of shop conduct; and the use of safety color coding in metal trades.
   b. Apply general safety rules for tool and shop equipment use including use of hand tools, air and electric power tools, and other shop equipment.
   c. Apply rules and procedures associated with fire safety including procedures for handling and storing flammable liquids and proper use of fire fighting devices.
   *Related Academic Topics (See Appendix A): C2, C4, S5, S6, S8*
   *Workplace Skills (See Appendix B): WP5*
4. Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.
   a. Recognize signal words and symbols that indicate severity of a hazard.
   b. Describe methods for reducing hazardous waste.

c. Describe procedures for storing hazardous waste.
d. Interpret data found on a hazardous material safety data sheet.
e. Describe general safety procedures for first aid and cleanup to follow in case of an accident involving hazardous materials.
f. Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.

*Related Academic Topics (See Appendix A): C1, C2, C4, S5, S8*
*Workplace Skills (See Appendix B): WP2, WP3, WP4, WP5, WP6*

5. Calculate measurements using fractions and decimals.
   a. Solve problems using fractions including conversion for performing addition, subtraction, multiplication, and division.
   b. Solve problems using decimals, including the addition, subtraction, multiplication, and division of decimal numbers.

   *Related Academic Topics (See Appendix A): C1, C5, M1, M4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP6*
6. Inspect a machined part as per specifications with various instruments.
   a. Measure a three dimensional part with a steel rule to the nearest 1/32 inch.
   b. Measure a workpiece with a combination set to lay out lines to the nearest 1/32 inch and angles to the nearest degree, and find the center of a round part.
   c. Measure various workpieces with a micrometer, outside vernier micrometer, and depth micrometer using vernier and digital scales, to the nearest 0.001 inch.
   d. Distinguish between materials used in the metal trades, including ferrous, non-ferrous, and non-metallic materials.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M3, S4*
   *Workplace Skills (See Appendix B): WP1, WP2, WP6*
7. Interpret blueprint symbols, abbreviations, alphabet of lines, types of views, and title blocks.
   a. Identify the meaning of common blueprint symbols including concentricity, straightness, perpendicularity, center line, and diameter.
   b. Describe the abbreviations commonly used on blueprints including the following: Cast iron (CI), Cold rolled steel (CRS), Cast steel (CS), Center to center (CC), Counterbore (C' Bore or CB), Countersink (Csk), Diameter (Dia), Finish (F or Fin), Square (SQ), Hexagon (Hex), Inside diameter (ID), Outside diameter (OD), Radius (R or Rad), Required (Req'd or Req), Pitch diameter (PROFESSIONAL DEVELOPMENT), Round (Rd), Symmetrical (SYM), Total indicator reading (TIR), Typical (TYP), Parallel (Par), United National Coarse (UNC), Unified National Fine (UNF), and American Standard Taper Pipe (NTP).
   c. Identify the alphabet of lines used on blueprints, including object lines, hidden lines, center line, extension line, dimension lines, section lines, cutting plane line, break lines, and phantom line.

d. Identify the types of views shown on blueprints including top, front, and right side.
e. Define the terms "dimension" including size, shape, location, and slots, and "tolerance" including the total variation permitted in the size of a part.
f. Identify methods for showing dimensions and tolerance including linear and angular dimensions and basic size, allowance, and actual size tolerance.
g. Interpret information found in the title block of a blueprint including drawing number, file number, name, sheet, scale, code identification number, signatures, tolerances, and revisions.

*Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4*
*Workplace Skills (See Appendix B): WP1, WP2, WP6*

8. Identify and describe hand tools and their safe use.
   a. Identify and describe rules for the safe use and care of common hand tools including machinist's vise, wrenches, pliers, files, screwdrivers, chisels, hacksaws, and hammers.
   b. Describe reasons for tap failure including wrong size tap, wrong size tap drill, dull tap, incorrectly aligned tap, tap wrench too large, bottoming out in blind hole, incorrect lubrication, and incorrect chip removal procedure.
   c. Determine the proper size tap drill by using a tap chart and identify thread forms including American National Thread and ACME.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M3, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP2, WP3*
9. Lay out and fabricate a given project using the combination square.
   a. Fabricate a project by performing layout using a combination square, cutting out using a saw, and filing to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M3, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP2, WP3*
10. Identify and describe the safe operation of the types of power saws to include care, cleaning, use, and performance of cutting operations.
    a. Identify and describe rules for safe use of power saws including adjustment of guide to thickness of material, use of pusher, and application of correct feed pressure, for different types of power saws, including vertical, horizontal, cut-off, and reciprocating.
    b. Describe factors that determine saw blade selection including type of material, thickness of material, and type of job, and examine chart and speed formula methods for determining band saw speeds for cutting different materials.
    c. Describe factors to consider in the care and cleaning of power saws including removal of chips with a brush, wiping the table with an oily rag, lubricating, checking guides, adjusting guides according to manufacturer's specifications, and coiling and uncoiling a band saw blade according to accepted industry standards.
    d. Lay out and cut stock with a band saw according to specifications.

*Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M3, S5, S6*
*Workplace Skills (See Appendix B): WP1, WP2, WP3*

11. Identify and describe the types of drilling machines, hand powered and drill press, and the rules for safe operation of each.
    a. Describe safety rules for the safe use of a hand power drill and drill press including clamping down work, wearing safety goggles, setting speed correctly, securing adapter in the spindle, removing chuck key from chuck, changing variable speed only when drill press motor is running, and reducing drill pressure upon point breakthrough.
    b. Identify work-holding and setup devices in drill press operations including vise, V-blocks, and hold-down clamps.
    c. Lay out holes and drill, ream, countersink, and counterbore according to project specifications.

    *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M3, S5, S6*
    *Workplace Skills (See Appendix B): WP1, WP2, WP3*
12. Identify and describe the basic equipment, setup, and safety rules for proper use of oxyacetylene equipment.
    a. Identify and describe safety rules and instructions for using oxyacetylene equipment including protective equipment such as goggles and gloves; safety clothing requirements; clearing of work area; oxyacetylene cylinders and gases; adjusting pressure regulator valves; and care of welding hoses, torch body, cutting torch, welding tips, and spark striker.
    b. Set up oxyacetylene welding and cutting equipment including securing cylinders to hand truck or wall; removing cylinder valve caps; examining cylinder valve threads for damage and wiping clean of dust, oil, or grease with a clean dry cloth; purging cylinder valves; installing regulators; installing hoses; and installing torch body and welding/cutting tips.
    c. Prepare oxyacetylene equipment for welding, cutting, and brazing including adjustment of regulator pressure, lighting of torch, and adjustment of flame; define the terms "backfire" and "flashback"; and state possible causes of flashback including failure to purge equipment, leaks from loose tips or tip nuts, incorrect gas pressure, tip held too close to work, insufficient volume of oxygen or acetylene, and using tip in confined area.
    d. Distinguish between fusion welding and brazing and the purpose of flux.

    *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, S5, S6*
    *Workplace Skills (See Appendix B): WP2, WP5, WP6*
13. Perform welding, cutting, and brazing operations with oxyacetylene equipment.
    a. Lay beads on a flat plate with and without filler rod including puddle control according to industry standards, and weld an outside corner joint in the flat position including puddle control and metal fusion.

b. Make 90-degree cuts on mild steel including control and handling of equipment according to industry standards, and braze weld a square groove butt joint in the flat position including control of temperature of base metal and filler rod.

*Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, S5, S6*
*Workplace Skills (See Appendix B): WP2, WP5, WP6*

14. Identify and describe procedures and processes for SMAW.
    a. Explain safety rules related to SMAW equipment and processes including electrical safety, handling of welding cables and containers, hazards of arc rays, protective clothing, and environmental safety requirements.
    b. Describe how flux-covered electrodes work including design of the metal core with flux coating, contribution of metal to the weld, and shielding to prevent oxidation; explain the meaning of the numbers in the AWS electrode code classification including prefix, tensile strength, position, and special characteristics; and identify welding symbols.
    c. Describe the basic elements and techniques of arc welding including electrode selection, welding speed, welding position, joint preparation, fit-up, polarity, striking and maintaining an arc, arc gap, operating speed, electrode angle, movement of electrode, and the characteristics of good and bad welds by identifying the effects of current, voltage, and speed.

    *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M4, S5, S6*
    *Workplace Skills (See Appendix B): WP1, WP2, WP4*

15. Demonstrate proper striking and restriking of an electrode, controlling the crater, backfilling a bead, and building a pad.
    a. Strike and re-strike an arc, crater, and backfill a bead while running a bead on mild steel plate.
    b. Build a pad in the flat position on mild steel, and fabricate a butt joint and a multiple pass T-joint in flat and horizontal positions in mild steel according to specifications.

    *Related Academic Topics (See Appendix A): S5*
    *Workplace Skills (See Appendix B): WP1, WP6*

16. Identify and describe safety rules that apply to the pedestal grinder, and perform inspection, maintenance, and grinding operations.
    a. Describe safety rules that apply to the pedestal grinder including wearing safety glasses, standing to side when turning on machine, gap between wheel and rest, conducting ring test when installing wheel, and correct feed.
    b. Inspect and maintain a pedestal grinder including checking a new wheel for cracks, replacing a wheel, and dressing a wheel, and grinding a high speed tool bit and twist drill to specifications.

    *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S4, S5*
    *Workplace Skills (See Appendix B): WP1, WP2, WP4*

17. Identify and compare shapes of single-point, carbide, and high speed steel cutting tools. Perform a free-hand grinding of a turning tool, facing tool, and a 60-degree threading tool.
    a. Identify and compare basic shapes of single-point cutting tools including: right handed and left handed turning, right handed and left handed facing, threading and parting, carbide and high speed steel cutting tools including advantages and disadvantages of each.
    b. Free-hand grind a turning tool, facing tool, and 60-degree threading tool; and sharpen a cutoff tool blade to specifications.

    *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S4, S5*
    *Workplace Skills (See Appendix B): WP1, WP2, WP4*
18. Identify safety rules and components of an engine lathe, to include use of accessories, care and cleaning, basic operations, lathe speeds, and feeds.
    a. Describe rules for the safe use of an engine lathe including eye protection, guards, tools, care and cleaning, and hazards associated with clothing and jewelry.
    b. Identify the components of an engine lathe and the function of each part including head stock, tail stock, bed, carriage, and common lathe accessories and function of each including drill chuck, sleeve adapter, lathe dog, knurling tool, steady rest, follow rest, taper attachment, three-jaw universal chuck, four-jaw independent chuck, collet chuck with drawbar and adapter, drive place, spindle adapter, dead center and live center, mandrill, micrometer carriage stop, pipe center, and face place.
    c. Describe the basic operations performed on a lathe including threading, drilling, forming, shouldering, reaming, tapping, grooving, boring, center drilling, facing, cutoff, filing, turning, knurling, chamfering, polishing, and tapering. Determine lathe speeds and feeds using shop formulas and charts.

    *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, M5, S4, S5*
    *Workplace Skills (See Appendix B): WP1, WP2, WP4*
19. Remove and install a lathe chuck, and perform lathe operations.
    a. Remove and install a lathe chuck following manufacturer's recommendations and perform a facing operation, face a part to length, perform a straight turning operation, turn a part with square shoulder to length, and perform a center-drilling operation according to layout specifications.
    b. Turn threads to specifications.

    *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S4, S5*
    *Workplace Skills (See Appendix B): WP1, WP2, WP5*

20. Identify and describe hand tools, sheet metal machines, and terms used in sheet metal work.
    a. Identify and describe the safe use of specialized hand tools and sheet metal working machines used in sheet metal work including: steel rule, dividers, squares, protractors, American and U.S. Standard metal gauges, metal marking devices, snips, punches, rivet sets, dollies, chisels, hammers, crimpers, hand seamer, dovetailer, files, hacksaw, screwdrivers, pliers, wrenches, pop rivet gun, and hand groover, adjustable bar folder, hand brake (cornice brake), box and pan brake, ring and circle shears, and notcher.
    b. Identify common seams, locks, edges, and notches used in sheet metal work including seams (groove lock, Pittsburgh, standing, soldered, and riveted); locks (drive cleat, S-cleat, standing S-cleat), edges (hem, double hem, standing hem, and wired edge), and notches (corner, lap, duct, 45-degree lap, center Pittsburgh, corner Pittsburgh, and dovetail); identify fasteners used in sheet metal work including rivets, screws, and bolts and nuts; and define basic geometric terms including parallel line layout, radial line, triangulation, circumference, diameter, radius, pi, area, perimeter, and volume.

    *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M7*
    *Workplace Skills (See Appendix B): WP2, WP5*
21. Fabricate sheet metal projects as assigned, using various hand tools and sheet metal machines.
    a. Fabricate metal rectangles, metal circles, form cylinders, a simple box, and straight duct to specifications; fabricate 90 degree (square throat and heel), 90 degree elbow (radius throat and heel), and simple offset.
    b. Fold, bend, hem, and make drive clips on a hand brake according to specifications.

    *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S5, S6*
    *Workplace Skills (See Appendix B): WP2, WP5, WP6*

CURRICULUM FRAMEWORK

**Course Name:** Metal Trades II

**Course CIP Code:** 48.0592

**Course Description:** The Secondary Metal Trades program is designed as a cluster program for preparation to enter the metal working trades and is offered in grades 11 and 12 in Mississippi high schools and area vocational schools. Metal Trades II requires that students choose one of two options (Advanced Welding Option or Advanced Machine Shop Option). The Advanced Welding Option includes units in Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Core Arc Welding (FCAW) (optional), and Gas Tungsten Arc Welding (GTAW) (optional). The Advanced Machine Shop Option includes units in Lathe Operations, Milling Operations, and Grinding Operations. (2-2½ Carnegie Units, depending upon time spent in the course)

**Competencies and Suggested Objectives: (Advanced Welding Options)**

1. Demonstrate proper safety practices and welding techniques for SMAW.
   a. Demonstrate and review safety rules and practices, including hand tools, power equipment, and personal safety.
   b. Construct a V-groove butt joint, a T-joint, and a lap joint in all positions according to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, M1, M4, M5, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP5, WP6*
2. Demonstrate and discuss proper GMAW safety procedures, applications, and the advantages and limitations of gas metal arc welding (GMAW), and identify the machine controls on a GMAW welder.
   a. Demonstrate safety procedures for GMAW, and describe applications for GMAW, including the welding of ferrous and non-ferrous metals.
   b. Compare the advantages and limitations of GMAW.
   c. Identify the machine controls on a GMAW welder including the function of each.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M4, M7, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
3. Describe the short circuit transfer and spray arc metal transfer process, rules for GMAW electrode selection, uses of the common shielding gases in GMAW, and setup and shutdown of GMAW equipment.
   a. Describe the short circuit transfer and spray arc metal transfer processes.
   b. Describe rules for GMAW electrode selection including short circuit transfer uses of small diameter wires .035" or larger and the uses of the common shielding gases in GMAW (argon, $CO_2$, and oxygen).

c. Set up GMAW equipment, perform short circuit transfer, and shut down equipment.

*Related Academic Topics (See Appendix A): C1, C2, C5, M1, M4, M7, S5, S6*
*Workplace Skills (See Appendix B): WP2, WP4,WP5*

4. Perform various welds in the flat position according to specifications.
   a. Fabricate a butt joint weld, a lap joint fillet weld, a T-joint fillet weld, and a V-groove butt joint weld in the flat and horizontal positions (vertical and overhead optional) according to specifications.

   *Related Academic Topics (See Appendix A): C2, C3, M1, M4, M5, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP5, WP6*
5. Demonstrate and describe proper safety practices required in FCAW, FCAW procedures, and major factors to consider when selecting FCAW electrodes.
   a. Demonstrate proper safety precautions required in FCAW including hand tools, power equipment, and personal safety.
   b. Describe FCAW procedures including dual-shield and self-shielding, and the 0major factors to consider when selecting FCAW electrodes including deposition rate, base metal, and shielding gas.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
6. Perform various welds in the flat position using FCAW techniques.
   a. Fabricate a multi-pass fillet weld and V-grooved butt joint weld in the flat and horizontal positions (vertical and overhead optional) using FCAW techniques according to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, M1, M4, M5, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP5, WP6*
7. Demonstrate and identify proper safety procedures, principles of GTAW, and setup of a GTAW welder.
   a. Demonstrate and describe proper safety precautions required in GTAW including hand tools, power equipment, and personal safety, and describe the principles of GTAW including heat generation, shielding gas, filler rod, and the different types of tungsten electrodes including color, finish, and application.
   b. Identify the major controls on a GTAW machine including the functions of each, the parts of a GTAW torch including the functions of each, and the different types of cups used on a GTAW torch including an application of each.
   c. Set up a GTAW welder including the adjustment of the flow meter regulator according to manufacturer's specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
8. Perform various welds in the flat position using proper GTAW techniques.
   a. Run stringer beads in the flat and horizontal positions (vertical and overhead optional).

b. Fabricate a square grove butt weld and a T-joint fillet weld in the flat and horizontal positions (vertical and overhead optional).

*Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
*Workplace Skills (See Appendix B): WP2, WP4, WP5*

9. Set up and apply safety procedures in operation of the plasma arc cutter (PAC).
   a. Identify the major components of a PAC.
   b. Apply safety procedures in operation of the PAC.
   c. Adjust airflow and temperature settings.
   d. Operate a PAC to cut mild steel.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M1, S5*
   *Workplace Skills (See Appendix B): WP2, WP4*

**Competencies and Suggested Objectives: (Advanced Machine Shop Option)**

1. Describe and identify safety precautions to be followed in using an engine lathe, methods for measuring thread pitch diameters, and calculation of dimensions using taper formulas.
   a. Describe safety precautions to be followed in using an engine lathe.
   b. Identify methods for measuring thread pitch diameters including micrometer and calipers.
   c. Calculate dimensions using taper formulas according to specifications.
   d. Obtain information from reference materials, such as the Machinist's Handbook.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
2. Perform various engine lathe operations according to specifications.
   a. Perform the following operations using an engine lathe: chamfer, recessing, knurling, drill and recess a hole, align and start a tap using a lathe center, and cutoff.
   b. Perform the following turning and cutting operations using an engine lathe: turn between centers; turn a taper with taper attachment, turn a taper with compound, boring, cut external threads to relief, pick up threads, and cut internal threads.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*

3. Describe and identify rules applying to milling machine safety; types of milling machines; major components of horizontal and vertical mills; work-holding devices, cutting tools, tool holders, and other attachments used with milling machines; and the different types of horizontal and vertical milling operations.
   a. Describe rules applying to milling machine safety including having safety guards in place, operating machines according to manufacturer's specifications, and wearing eye protection.
   b. Identify the types of milling machines including vertical and horizontal. Describe the major components of horizontal and vertical mills including base, head, table, saddle, and knee.
   c. Identify work-holding devices, cutting tools, tool holders, and other attachments used with milling machines including vises and holding clamps, end mill, and milling cutters.
   d. Describe the different types of horizontal milling operations including key cutting, spline cutting, angle cutting, and slotting, and the different types of vertical milling machine operations including key cutting, spline cutting, angle cutting, boring, drilling, and slotting.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
4. Adjust horizontal milling machine speed and feed rates, clean and lubricate a horizontal mill, mount arbors and adjust arbor support bushing on a horizontal milling machine, mount a cutter to a horizontal milling machine arbor, mill a keyway, and perform selected horizontal milling operations.
   a. Adjust machine speed and feed rates, and clean and lubricate a horizontal mill.
   b. Mount arbors and adjust arbor support bushing on a horizontal milling machine, and mount a cutter to a horizontal milling machine arbor according to specifications.
   c. Perform selected horizontal milling operations according to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
5. Mount and remove cutters and cutter holders for vertical spindle milling machines, align a vise on a vertical milling machine using dial indicator, and perform selected vertical milling and boring operations.
   a. Mount and remove cutters and cutter holders for vertical spindle milling machines, and mount and align a vise on a vertical milling machine.
   b. Perform selected vertical milling and boring operations according to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*

6. Describe safety procedures for grinding machine safety, magnetic chuck work, surface grinding operations, and reasons for truing and balancing a grinding wheel.
   a. Describe rules for grinding machine safety including standing to the right front side of the machine when in operation, having safety guards in place, conducting ring test when installing new grinding wheel, operating according to manufacturer's specifications, and wearing protective equipment.
   b. Describe safety rules that apply to magnetic chuck work including cleaning, deburring, and operating according to manufacturer's specifications.
   c. Identify surface grinding operations including grinding flat surfaces, edges, cut-off, slots, and angle surfaces.
   d. Explain reasons for truing and balancing grinding wheels including making wheel concentric, eliminating chatter marks, eliminating vibration, and removing glazing.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
7. Perform maintenance operations on a bench grinder to manufacturer's specifications and grinding operations to teacher's specifications.
   a. Remove and replace a grinding wheel on a grinding machine according to manufacturer's specifications.
   b. Dress a grinding machine wheel flat according to manufacturer's specifications.
   c. Grind a workpiece flat and parallel according to manufacturer's specifications. Grind a workpiece square, an angular surface, and to dimension according to teacher's specifications.

   *Related Academic Topics (See Appendix A): C1, C2,* C6, M1, M2, M4
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*

# SECTION II:

# CURRICULUM GUIDE

# FOR

# METAL TRADES

# METAL TRADES I

## METAL TRADES I
## UNIT 1: ORIENTATION AND SAFETY (5 days)

**Competencies and Suggested Objectives:**

1. Demonstrate the student school handbook and classroom policies.
   a. Identify policies found in the school handbook.
   b. Identify classroom rules and policies.
   *Related Academic Topics (See Appendix A): C1, C2, C3*
   *Workplace Skills (See Appendix B): WP2, WP6*
2. Review occupational and leadership opportunities in metal trades.
   a. Investigate occupational opportunities in the local area.
   b. Update the student's Career/Educational Plan.
   c. Describe leadership opportunities available from student youth organizations in the school and community, including VICA.
   *Related Academic Topics (See Appendix A): C1, C4, C6*
   *Workplace Skills (See Appendix B): WP2, WP3, WP6*
3. Demonstrate safety procedures used in metal trades.
   a. Apply safety rules for personal and general shop safety including eye (State Eye Safety Law provisions), ear, and body protection; general rules of shop conduct; and the use of safety color coding in metal trades.
   b. Apply general safety rules for tool and shop equipment use including use of hand tools, air and electric power tools, and other shop equipment.
   c. Apply rules and procedures associated with fire safety including procedures for handling and storing flammable liquids and proper use of fire fighting devices.
   *Related Academic Topics (See Appendix A): C2, C4, S5, S6, S8*
   *Workplace Skills (See Appendix B): WP5*
4. Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.
   a. Recognize signal words and symbols that indicate severity of a hazard.
   b. Describe methods for reducing hazardous waste.
   c. Describe procedures for storing hazardous waste.
   d. Interpret data found on a hazardous material safety data sheet.
   e. Describe general safety procedures for first aid and cleanup to follow in case of an accident involving hazardous materials.
   f. Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.
   *Related Academic Topics (See Appendix A): C1, C2, C4, S5, S8*
   *Workplace Skills (See Appendix B): WP2, WP3, WP4, WP5, WP6*

***Suggested Teaching Strategies:***

1. *Demonstrate the student school handbook and classroom policies.*
   a. *Discuss school handbook with students.*
   b. *Discuss classroom policies with students.*
2. *Review occupational and leadership opportunities in metal trades.*
   a. *Have student survey job opportunities through employer visits, resource person(s), telephone calls, help-wanted ads, or a field trip and then report their findings to the class.*
   b. *Have student update his/her Career/Educational Plan to reflect accomplishments and plans for future educational and occupational activities.*
   c. *Discuss leadership opportunities with the students, such as competitive events (VICA), award and degree programs, and committee work, that are provided through student and youth organizations. Allow students to practice leadership in class and laboratory activities.*
3. *Demonstrate safety procedures used in metal trades.*
   a. *Provide students with reading material on safety rules related to personal safety and general shop safety.*
   b. *Demonstrate the safety rules and procedures for using tools and shop equipment. Provide simulations to allow students to practice these rules. Monitor students throughout the year on using these rules.*
   c. *Invite the local fire department to give a demonstration of fire safety and the use of fire detection and fighting equipment. Identify fire safety equipment, its location, and application(s) in the metal trades laboratory and instruct students on its use.*
4. *Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.*
   a. *Provide students with handouts or reading materials on the handling, storing, and disposing of hazardous materials. Discuss the use of signal words and methods for reducing and storing hazardous waste.*
   b. *Provide students with a copy of a hazardous material safety data sheet. Review and interpret the data found on the sheet with the class. Provide students with a second MSD for their interpretation.*
   c. *Provide students with information (text or videotape) on first aid and clean-up procedures in case of a hazardous material accident. Discuss these procedures with the class. Allow students to practice these procedures through a simulation.*
   d. *Discuss and demonstrate the procedures for handling, storing, and disposing of hazardous waste with the students. Have student practice these procedures through a simulation. Monitor students for compliance with these procedures throughout the year.*

***Suggested Assessment Strategies:***

1. *Demonstrate the student school handbook and classroom policies.*
   a. *Monitor student behavior for compliance with school handbook.*
   b. *Monitor student behavior for compliance with classroom policies.*
2. *Review occupational and leadership opportunities in metal trades.*
   a. *Oral and/or written report on job opportunities.*
   b. *Review of Career/Educational Plan update.*
   c. *Participation in leadership activities in class or laboratory.*
3. *Demonstrate safety procedures used in metal trades.*
   a. *Unit test on safety procedures, equipment, and rules with one hundred per cent score and test on file.*
   b. *Monitor students to assure that compliance with safety procedures becomes an integral part of their work habits.*
4. *Describe procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.*
   a. *Test on hazardous materials – signal words, reducing and storing, MSD's, and safety/first aid procedures.*
   b. *Student exercise – Hazardous material accident simulation.*
   c. *Student exercise – Handling, storing, and disposing of hazardous materials.*
   d. *Monitor students to assure that compliance with hazardous materials procedures becomes an integral part of their work habits.*

**Suggested References:**

American Vocational Association. Hazardous Materials Fingertip Retrieval System. Alexandria, VA: American Vocational Association. 1991.

Curriculum and Instructional Materials Center (CIMC). Machine Shop I. Stillwater, OK: Oklahoma State Department of Vocational-Technical Education. 1982.

**METAL TRADES I**
**UNIT 2: MEASUREMENT, INSPECTIONS, AND BLUEPRINTS (15 days)**

**Competencies and Suggested Objectives:**

1. Calculate measurements using fractions and decimals.
   a. Solve problems using fractions including conversion for performing addition, subtraction, multiplication, and division.
   b. Solve problems using decimals, including the addition, subtraction, multiplication, and division of decimal numbers.

   *Related Academic Topics (See Appendix A): C1, C5, M1, M4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP6*
2. Inspect a machined part as per specifications with various instruments.
   a. Measure a three dimensional part with a steel rule to the nearest 1/32 inch.
   b. Measure a workpiece with a combination set to lay out lines to the nearest 1/32 inch and angles to the nearest degree, and find the center of a round part.
   c. Measure various workpieces with a micrometer, outside vernier micrometer, and depth micrometer using vernier and digital scales, to the nearest 0.001 inch.
   d. Distinguish between materials used in the metal trades, including ferrous, non-ferrous, and non-metallic materials.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M3, S4*
   *Workplace Skills (See Appendix B): WP1, WP2, WP6*
3. Interpret blueprint symbols, abbreviations, alphabet of lines, types of views, and title blocks.
   a. Identify the meaning of common blueprint symbols including concentricity, straightness, perpendicularity, center line, and diameter.
   b. Describe the abbreviations commonly used on blueprints including the following: Cast iron (CI), Cold rolled steel (CRS), Cast steel (CS), Center to center (CC), Counterbore (C' Bore or CB), Countersink (Csk), Diameter (Dia), Finish (F or Fin), Square (SQ), Hexagon (Hex), Inside diameter (ID), Outside diameter (OD), Radius (R or Rad), Required (Req'd or Req), Pitch diameter (PD), Round (Rd), Symmetrical (SYM), Total indicator reading (TIR), Typical (TYP), Parallel (Par), United National Coarse (UNC), Unified National Fine (UNF), and American Standard Taper Pipe (NTP).
   c. Identify the alphabet of lines used on blueprints, including object lines, hidden lines, center line, extension line, dimension lines, section lines, cutting plane line, break lines, and phantom line.
   d. Identify the types of views shown on blueprints including top, front, and right side.
   e. Define the terms "dimension" including size, shape, location, and slots, and "tolerance" including the total variation permitted in the size of a part.

f. Identify methods for showing dimensions and tolerance including linear and angular dimensions and basic size, allowance, and actual size tolerance.
g. Interpret information found in the title block of a blueprint including drawing number, file number, name, sheet, scale, code identification number, signatures, tolerances, and revisions.

*Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4*
*Workplace Skills (See Appendix B): WP1, WP2, WP6*

***Suggested Teaching Strategies:***

1. *Calculate measurements using fractions and decimals.*
   a. *Demonstrate to the student how to solve problems using fractions with addition, subtraction, multiplication, and division, and have the student solve practice problems.*
   b. *Demonstrate to the student how to solve problems using decimals with addition, subtraction, multiplication, and division, and have the student solve practice problems.*
2. *Inspect a machined part as per specifications with various instruments.*
   a. *Discuss with the student how a steel rule is used for measuring and layout, and demonstrate proper measuring technique. Have the student complete a practice measurement activity.*
   b. *Discuss with the student how a combination set is used for measuring and layout, and demonstrate proper measuring technique. Have the student complete a practice measurement activity.*
   c. *Discuss with the student how a micrometer is used for measuring and its proper use and storage. Demonstrate proper handling and measurement technique. Have the student complete a practice measurement activity.*
   d. *Describe the properties of materials used in the machine trades, and how those properties determine use. Provide samples of different materials for student examination.*
3. *Interpret blueprint symbols, abbreviations, alphabet of lines, types of views, and title blocks.*
   a. *Provide charts with blueprint symbols for student use, and interpret these symbols on a set of prints through class discussion.*
   b. *Discuss common blueprint symbols with the student and interpret these symbols on a set of prints through class discussion. Have students practice drawing blueprint symbols.*
   c. *Discuss the alphabet of lines with the student and interpret these on a set of drawings through class discussion. Have students practice drawing different lines.*
   d. *Provide a three dimensional model to demonstrate the different views that are represented on a drawing, and discuss these different views.*
   e. *Discuss the terms related to dimensioning and provide student handouts or assign reading that reinforces the application of the terminology.*

f. *Invite local industry representatives to discuss standardized methods of detailing drawings in the areas of dimensions, tolerances, allowances, and size.*
g. *Discuss with the student information found in a title block and relate that information to previously discussed material through a review of applicable topics. Have the student prepare a title block as a practice activity.*

***Suggested Assessment Strategies:***

1. *Calculate measurements using fractions and decimals.*
   a. *Test on the conversion of fractions to perform addition, subtraction, multiplication, and division related to problem solving in the metal trades.*
   b. *Test on the addition, subtraction, multiplication, and division of decimal numbers related to problem solving in the metal trades.*
2. *Inspect a machined part as per specifications with various instruments.*
   a. *Student exercise – Measurement of three dimensional part with a steel rule.*
   b. *Student exercise – Measurement of workpiece with combination set.*
   c. *Student exercise – Measurement of workpiece with various micrometers.*
   d. *Test student on proper identification and use of materials used in metal trades.*
3. *Interpret blueprint symbols, abbreviations, alphabet of lines, types of views, and title blocks.*
   a. *Test on visually identifying blueprint symbols, and interpreting the meaning of each.*
   b. *Test on describing the meaning of abbreviations found on blueprints.*
   c. *Test on interpreting the identity of the alphabet of lines as discussed and practiced in class.*
   d. *Student exercise – Identify the different pictorial views found on a blueprint.*
   e. *Test on the different components of dimensioning.*
   f. *Student exercise – Identify industry methods for showing dimensions and tolerances.*
   g. *Student exercise – Demonstrate ability to interpret information found in the title block of a technical drawing.*

**Suggested References:**

Dunn, J. Machine Shop I. Stillwater, OK: Oklahoma Department of Vocational and Technical Education. 1982.

**METAL TRADES I**
**UNIT 3: BENCH WORK** **(15 days)**

**Competencies and Suggested Objectives:**

1. Identify and describe hand tools and their safe use.
   a. Identify and describe rules for the safe use and care of common hand tools including machinist's vise, wrenches, pliers, files, screwdrivers, chisels, hacksaws, and hammers.
   b. Describe reasons for tap failure including wrong size tap, wrong size tap drill, dull tap, incorrectly aligned tap, tap wrench too large, bottoming out in blind hole, incorrect lubrication, and incorrect chip removal procedure.
   c. Determine the proper size tap drill by using a tap chart and identify thread forms including American National Thread and ACME.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M3, S5, S6,*
   *Workplace Skills (See Appendix B): WP1, WP2, WP3*
2. Lay out and fabricate a given project using the combination square.
   a. Fabricate a project by performing layout using a combination square, cutting out using a saw, and filing to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M3, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP2, WP3*

***Suggested Teaching Strategies:***

1. *Identify and describe hand tools and their safe use.*
   a. *Demonstrate the safety rules for proper hand tool operation, and provide simulations to allow student practice. Provide safety information in the form of student handouts.*
   b. *Discuss and demonstrate use of taps, and provide student with practice experience.*
   c. *Provide chart handouts on tap drill sizes to students, and discuss proper use of chart for correct tap drill selection.*
2. *Lay out and fabricate a given project using the combination square.*
   a. *Summarize information needed by the student to safely complete the project to specifications.*

***Suggested Assessment Strategies:***

1. *Identify and describe hand tools and their safe use.*
   a. *Monitor the student for safe and proper use of hand tools.*
   b. *Student exercise – Demonstrate proper tap technique through use.*
   c. *Student exercise – Demonstrate proper tap drill selection through use.*

2. *Lay out and fabricate a given project using the combination square.*
   a. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

Dunn, J. Machine Shop I. Stillwater, OK: Oklahoma Department of Vocational and Technical Education. 1982.

## METAL TRADES I
## UNIT 4: POWER SAWS AND DRILLING MACHINES (5 days)

**Competencies and Suggested Objectives:**

1. Identify and describe the safe operation of the types of power saws to include care, cleaning, use, and performance of cutting operations.
   a. Identify and describe rules for safe use of power saws including adjustment of guide to thickness of material, use of pusher, and application of correct feed pressure, for different types of power saws, including vertical, horizontal, cut-off, and reciprocating.
   b. Describe factors that determine saw blade selection including type of material, thickness of material, and type of job, and examine chart and speed formula methods for determining band saw speeds for cutting different materials.
   c. Describe factors to consider in the care and cleaning of power saws including removal of chips with a brush, wiping the table with an oily rag, lubricating, checking guides, adjusting guides according to manufacturer's specifications, and coiling and uncoiling a band saw blade according to accepted industry standards.
   d. Lay out and cut stock with a band saw according to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M3, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP2, WP3*
2. Identify and describe the types of drilling machines, hand powered and drill press, and the rules for safe operation of each.
   a. Describe safety rules for the safe use of a hand power drill and drill press including clamping down work, wearing safety goggles, setting speed correctly, securing adapter in the spindle, removing chuck key from chuck, changing variable speed only when drill press motor is running, and reducing drill pressure upon point breakthrough.
   b. Identify work-holding and setup devices in drill press operations including vise, V-blocks, and hold-down clamps.
   c. Lay out holes and drill, ream, countersink, and counterbore according to project specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M3, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP2, WP3*

***Suggested Teaching Strategies:***

1. *Identify and describe the safe operation of the types of power saws to include care, cleaning, use, and performance of cutting operations.*
   a. *Demonstrate the safety rules for proper power saw operation, and provide simulations to allow student practice. Provide safety information in the form of student handouts.*
   b. *Discuss proper blade selection in relation to material being cut. Provide student handouts that chart speed and selection criteria to enable safe operation.*
   c. *Demonstrate proper cleaning and maintenance procedures for power saws, and provide student with supervised practice.*
   d. *Demonstrate layout of stock and safe use of bandsaw.*
2. *Identify and describe the types of drilling machines, hand powered and drill press, and the rules for safe operation of each.*
   a. *Demonstrate the safety rules for proper hand power drill operation, and provide simulations to allow student practice. Provide safety information in the form of student handouts.*
   b. *Discuss material holding devices and demonstrate proper use.*
   c. *Demonstrate layout and performance of drilling operations.*

***Suggested Assessment Strategies:***

1. *Identify and describe the safe operation of the types of power saws to include care, cleaning, use, and performance of cutting operations.*
   a. *Monitor student performance for safe and proper operation of power saws.*
   b. *Student exercise – Match correct saw with the desired operation and material to be cut.*
   c. *Monitor student performance for care, cleaning, and proper adjustment of machines.*
   d. *Performance test – Monitor student performance for safe and proper operation of bandsaw.*
2. *Identify and describe the types of drilling machines, hand powered and drill press, and the rules for safe operation of each.*
   a. *Monitor student performance for safe and proper operation of drilling machines.*
   b. *Monitor student performance for safe and proper operation of work-holding and setup devices.*
   c. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

Dunn, J. Machine Shop I. Stillwater, OK: Oklahoma Department of Vocational and Technical Education. 1982.

## METAL TRADES I
## UNIT 5: BASIC OXYACETYLENE WELDING, CUTTING, AND BRAZING (15 days)

**Competencies and Suggested Objectives:**

1. Identify and describe the basic equipment, setup, and safety rules for proper use of oxyacetylene equipment.
   a. Identify and describe safety rules and instructions for using oxyacetylene equipment including protective equipment such as goggles and gloves; safety clothing requirements; clearing of work area; oxyacetylene cylinders and gases; adjusting pressure regulator valves; and care of welding hoses, torch body, cutting torch, welding tips, and spark striker.
   b. Set up oxyacetylene welding and cutting equipment including securing cylinders to hand truck or wall; removing cylinder valve caps; examining cylinder valve threads for damage and wiping clean of dust, oil, or grease with a clean dry cloth; purging cylinder valves; installing regulators; installing hoses; and installing torch body and welding/cutting tips.
   c. Prepare oxyacetylene equipment for welding, cutting, and brazing including adjustment of regulator pressure, lighting of torch, and adjustment of flame; define the terms "backfire" and "flashback"; and state possible causes of flashback including failure to purge equipment, leaks from loose tips or tip nuts, incorrect gas pressure, tip held too close to work, insufficient volume of oxygen or acetylene, and using tip in confined area.
   d. Distinguish between fusion welding and brazing and the purpose of flux.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP5, WP6*
2. Perform welding, cutting, and brazing operations with oxyacetylene equipment.
   a. Lay beads on a flat plate with and without filler rod including puddle control according to industry standards, and weld an outside corner joint in the flat position including puddle control and metal fusion.
   b. Make 90-degree cuts on mild steel including control and handling of equipment according to industry standards, and braze weld a square groove butt joint in the flat position including control of temperature of base metal and filler rod.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP5, WP6*

***Suggested Teaching Strategies:***

1. *Identify and describe the basic equipment, setup, and safety rules for proper use of oxyacetylene (OAC) equipment.*
   a. *Demonstrate the safety rules and instructions for using oxyacetylene equipment, and provide simulations to allow student practice. Provide safety information in the form of student handouts.*
   b. *Demonstrate setup of oxyacetylene equipment.*
   c. *Demonstrate regulator adjustment, torch lighting, different types of flames, and causes of backfire and flashback.*
   d. *Discuss proper selection and handling of filler rods.*
   e. *Discuss difference between fusion welding and brazing.*
2. *Perform welding, cutting, and brazing operations with OAC equipment.*
   a. *Demonstrate running a bead with and without filler rod, and weld a corner joint in the flat position.*
   b. *Demonstrate proper cutting and brazing technique.*

***Suggested Assessment Strategies:***

1. *Identify and describe the basic equipment, setup, and safety rules for proper use of oxyacetylene (OAC) equipment.*
   a. *Unit test on safety rules and equipment used in OAC welding.*
   b. *Student activity – Setup of OAC equipment according to industry standards.*
   c. *Student activity – Preparation of OAC equipment and torch lighting.*
   d. *Monitor student for proper rod selection and rod handling and storage.*
   e. *Test on distinguishing between fusion welding and brazing.*
2. *Perform welding, cutting, and brazing operations with OAC equipment.*
   a. *Monitor student performance for safe and proper operation of OAC equipment in the assigned activity.*
   b. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

MAVCC. Fundamentals of Welding. Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1992.

MAVCC. Oxyacetylene Welding and Cutting. Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1992.

**METAL TRADES I**
**UNIT 6: BASIC SHIELDED ARC METAL WELDING** **(25 days)**

**Competencies and Suggested Objectives:**

1. Identify and describe procedures and processes for SMAW.
   a. Explain safety rules related to SMAW equipment and processes including electrical safety, handling of welding cables and containers, hazards of arc rays, protective clothing, and environmental safety requirements.
   b. Describe how flux-covered electrodes work including design of the metal core with flux coating, contribution of metal to the weld, and shielding to prevent oxidation; explain the meaning of the numbers in the AWS electrode code classification including prefix, tensile strength, position, and special characteristics; and identify welding symbols.
   c. Describe the basic elements and techniques of arc welding including electrode selection, welding speed, welding position, joint preparation, fit-up, polarity, striking and maintaining an arc, arc gap, operating speed, electrode angle, movement of electrode, and the characteristics of good and bad welds by identifying the effects of current, voltage, and speed.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4*
2. Demonstrate proper striking and restriking of an electrode, controlling the crater, backfilling a bead, and building a pad.
   a. Strike and re-strike an arc, crater, and backfill a bead while running a bead on mild steel plate.
   b. Build a pad in the flat position on mild steel, and fabricate a butt joint and a multiple pass T-joint in flat and horizontal positions in mild steel according to specifications.

   *Related Academic Topics (See Appendix A): S5*
   *Workplace Skills (See Appendix B): WP1, WP6*

***Suggested Teaching Strategies:***

1. *Identify and describe procedures and processes for SMAW.*
   *a. Demonstrate safety rules and instructions for using SMAW equipment, and provide simulations to allow student practice. Provide safety information in the form of student handouts.*
   *b. Discuss electrode construction, classification, and operation.*
   *c. Discuss basic elements and techniques of arc welding. Provide models that exhibit good and bad welds.*

2. *Demonstrate proper striking and restriking of an electrode, controlling the crater, backfilling a bead, and building a pad.*
   a. *Demonstrate proper welding technique and allow for student practice.*
   b. *Demonstrate proper welding technique and allow for student practice.*

***Suggested Assessment Strategies:***

1. *Identify and describe procedures and processes for SMAW.*
   a. *Unit test on safety related to SMAW equipment and procedures.*
   b. *Test on material related to electrode operation and specifications.*
   c. *Monitor student for proper application of basic elements and techniques in a practice session.*
2. *Demonstrate proper striking and restriking of an electrode, controlling the crater, backfilling a bead, and building a pad.*
   a. *Student activity – Practice safe and proper operation of welding equipment in the assigned activity.*
   b. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

MAVCC. Fundamentals of Welding. Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1992.

MAVCC. Shielded Metal Arc Welding (SMAW). Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1992.

**METAL TRADES I**
**UNIT 7: BASIC MACHINE SHOP** **(40 days)**

**Competencies and Suggested Objectives:**

1. Identify and describe safety rules that apply to the pedestal grinder, and perform inspection, maintenance, and grinding operations.
   a. Describe safety rules that apply to the pedestal grinder including wearing safety glasses, standing to side when turning on machine, gap between wheel and rest, conducting ring test when installing wheel, and correct feed.
   b. Inspect and maintain a pedestal grinder including checking a new wheel for cracks, replacing a wheel, and dressing a wheel, and grinding a high speed tool bit and twist drill to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S4, S5*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4*
2. Identify and compare shapes of single-point, carbide, and high speed steel cutting tools. Perform a free-hand grinding of a turning tool, facing tool, and a 60-degree threading tool.
   a. Identify and compare basic shapes of single-point cutting tools including: right handed and left handed turning, right handed and left handed facing, threading and parting, carbide and high speed steel cutting tools including advantages and disadvantages of each.
   b. Free-hand grind a turning tool, facing tool, and 60-degree threading tool; and sharpen a cutoff tool blade to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S4, S5*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4*
3. Identify safety rules and components of an engine lathe, to include use of accessories, care and cleaning, basic operations, lathe speeds, and feeds.
   a. Describe rules for the safe use of an engine lathe including eye protection, guards, tools, care and cleaning, and hazards associated with clothing and jewelry.
   b. Identify the components of an engine lathe and the function of each part including head stock, tail stock, bed, carriage, and common lathe accessories and function of each including drill chuck, sleeve adapter, lathe dog, knurling tool, steady rest, follow rest, taper attachment, three-jaw universal chuck, four-jaw independent chuck, collet chuck with drawbar and adapter, drive place, spindle adapter, dead center and live center, mandrill, micrometer carriage stop, pipe center, and face place.
   c. Describe the basic operations performed on a lathe including threading, drilling, forming, shouldering, reaming, tapping, grooving, boring, center drilling, facing, cutoff, filing, turning, knurling, chamfering, polishing, and tapering. Determine lathe speeds and feeds using shop formulas and charts.

*Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, M5, S4, S5*
*Workplace Skills (See Appendix B): WP1, WP2, WP4*

4. Remove and install a lathe chuck, and perform lathe operations.
   a. Remove and install a lathe chuck following manufacturer's recommendations and perform a facing operation, face a part to length, perform a straight turning operation, turn a part with square shoulder to length, and perform a center-drilling operation according to layout specifications.
   b. Turn threads to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S4, S5*
   *Workplace Skills (See Appendix B): WP1, WP2, WP5*

***Suggested Teaching Strategies:***

1. *Identify and describe safety rules that apply to the pedestal grinder, and perform inspection, maintenance, and grinding operations.*
   a. *Demonstrate safety rules and instructions for using a pedestal grinder, and provide simulations to allow student practice. Provide safety information in the form of student handouts.*
   b. *Demonstrate inspection, maintenance, and grinding procedures.*
2. *Identify and compare shapes of single-point, carbide, and high speed steel cutting tools. Perform a free-hand grinding of a turning tool, facing tool, and a 60-degree threading tool.*
   a. *Discuss cutting tools.*
   b. *Demonstrate grinding cutting tools.*
3. *Identify safety rules and components of an engine lathe, to include use of accessories, care and cleaning, basic operations, lathe speeds, and feeds.*
   a. *Demonstrate safety rules and instructions for using an engine lathe, and provide simulations to allow student practice. Provide safety information in the form of student handouts.*
   b. *Discuss individual components of an engine lathe and the function of each.*
   c. *Discuss basic lathe operations and demonstrate these operations on an engine lathe.*
4. *Remove and install a lathe chuck, and perform lathe operations.*
   a. *Demonstrate installation of lathe chuck and lathe operations, and allow for student practice of these operations.*
   b. *Demonstrate turning threads to specifications.*

***Suggested Assessment Strategies:***

1. *Identify and describe safety rules that apply to the pedestal grinder, and perform inspection, maintenance, and grinding operations.*
   a. *Unit test on safety related to basic machine shop equipment and procedures.*
   b. *Student activity – Perform inspection, maintenance, and grinding operations.*
2. *Identify and compare shapes of single-point, carbide, and high speed steel cutting tools. Perform a free-hand grinding of a turning tool, facing tool, and a 60-degree threading tool.*
   a. *Student Activity – Identify cutting tools and their appropriate use.*
   b. *Student Activity – Perform grinding operations.*
3. *Identify safety rules and components of an engine lathe, to include use of accessories, care and cleaning, basic operations, lathe speeds, and feeds.*
   a. *Unit test on safety related to engine lathe equipment and procedures.*
   b. *Monitor student use of lathe components.*
   c. *Monitor student completing basic operations on the lathe.*
4. *Remove and install a lathe chuck, and perform lathe operations.*
   a. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*
   b. *Student Activity - Turn threads to specifications.*

**Suggested References:**

Dunn, J. Machine Shop I. Stillwater, OK: Oklahoma Department of Vocational and Technical Education. 1982.

**METAL TRADES I**
**UNIT 8: BASIC SHEET METAL REPAIR** **(15 days)**

**Competencies and Suggested Objectives:**

1. Identify and describe hand tools, sheet metal machines, and terms used in sheet metal work.
   a. Identify and describe the safe use of specialized hand tools and sheet metal working machines used in sheet metal work including: steel rule, dividers, squares, protractors, American and U.S. Standard metal gauges, metal marking devices, snips, punches, rivet sets, dollies, chisels, hammers, crimpers, hand seamer, dovetailer, files, hacksaw, screwdrivers, pliers, wrenches, pop rivet gun, and hand groover, adjustable bar folder, hand brake (cornice brake), box and pan brake, ring and circle shears, and notcher.
   b. Identify common seams, locks, edges, and notches used in sheet metal work including seams (groove lock, Pittsburgh, standing, soldered, and riveted); locks (drive cleat, S-cleat, standing S-cleat), edges (hem, double hem, standing hem, and wired edge), and notches (corner, lap, duct, 45-degree lap, center Pittsburgh, corner Pittsburgh, and dovetail); identify fasteners used in sheet metal work including rivets, screws, and bolts and nuts; and define basic geometric terms including parallel line layout, radial line, triangulation, circumference, diameter, radius, pi, area, perimeter, and volume.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M7*
   *Workplace Skills (See Appendix B): WP2, WP5*
2. Fabricate sheet metal projects as assigned, using various hand tools and sheet metal machines.
   a. Fabricate metal rectangles, metal circles, form cylinders, a simple box, and straight duct to specifications; fabricate 90 degree (square throat and heel), 90 degree elbow (radius throat and heel), and simple offset.
   b. Fold, bend, hem, and make drive clips on a hand brake according to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP5, WP6*

***Suggested Teaching Strategies:***

1. *Identify and describe hand tools, sheet metal machines, and terms used in sheet metal work.*
   a. *Demonstrate safety rules and instructions for using hand tools and sheet metal machines, and provide simulations to allow student practice. Provide safety information in the form of student handouts.*

   b. *Discuss methods for connecting sheet metal, and geometric terms.*
2. *Fabricate sheet metal projects as assigned, using various hand tools and sheet metal machines.*
   a. *Demonstrate fabrication of different geometric sheet metal configurations using sheet metal tools and machines.*
   b. *Demonstrate fabrication of drive clips using sheet metal tools and machines.*

***Suggested Assessment Strategies:***

1. *Identify and describe hand tools, sheet metal machines, and terms used in sheet metal work.*
   a. *Unit test on safety related to sheet metal hand tools, equipment, and procedures.*
   b. *Student activity – Identify common methods for connecting sheet metal and geometric shapes.*
2. *Fabricate sheet metal projects as assigned, using various hand tools and sheet metal machines.*
   a. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*
   b. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

MAVCC. Basic Sheet Metal Layout and Fabrication. Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1983.

MAVCC. Sheet Metal Basics. Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1983.

# METAL TRADES II
## (Advanced Welding Option)

**METAL TRADES II (Advanced Welding Option)**
**UNIT A1: SHIELDED METAL ARC WELDING (SMAW)** **(50 days)**

**Competencies and Suggested Objectives:**

1. Demonstrate proper safety practices and welding techniques for SMAW.
   a. Demonstrate and review safety rules and practices, including hand tools, power equipment, and personal safety.
   b. Construct a V-groove butt joint, a T-joint, and a lap joint in all positions according to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, M1, M4, M5, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP5, WP6*

***Suggested Teaching Strategies:***

1. *Demonstrate proper safety practices, and welding techniques for SMAW.*
   a. *Review safety procedures, and discuss welding techniques.*
   b. *Demonstrate fabrication of welded joints.*

***Suggested Assessment Strategies:***

1. *Demonstrate proper safety practices and welding techniques for SMAW.*
   a. *Monitor student in the use of safety procedures.*
   b. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

MAVCC. Shielded Metal Arc Welding (SMAW). Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1992.

**METAL TRADES II (Advanced Welding Option)**
**UNIT A2: GAS METAL ARC WELDING (GMAW)** **(50 days)**

**Competencies and Suggested Objectives:**

1. Demonstrate and discuss proper GMAW safety procedures, applications, and the advantages and limitations of gas metal arc welding (GMAW), and identify the machine controls on a GMAW welder.
   a. Demonstrate safety procedures for GMAW, and describe applications for GMAW, including the welding of ferrous and non-ferrous metals.
   b. Compare the advantages and limitations of GMAW.
   c. Identify the machine controls on a GMAW welder including the function of each.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M4, M7, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
2. Describe the short circuit transfer and spray arc metal transfer process, rules for GMAW electrode selection, uses of the common shielding gases in GMAW, and setup and shutdown of GMAW equipment.
   a. Describe the short circuit transfer and spray arc metal transfer processes.
   b. Describe rules for GMAW electrode selection including short circuit transfer uses of small diameter wires .035 or larger and the uses of the common shielding gases in GMAW (argon, $CO_2$, and oxygen).
   c. Set up GMAW equipment, perform short circuit transfer, and shut down equipment.

   *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M4, M7, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4,WP5*
3. Perform various welds in the flat position according to specifications.
   a. Fabricate a butt joint weld, a lap joint fillet weld, a T-joint fillet weld, and a V-groove butt joint weld in the flat and horizontal positions (vertical and overhead optional) according to specifications.

   *Related Academic Topics (See Appendix A): C2, C3, M1, M4, M5, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP5, WP6*

***Suggested Teaching Strategies:***

1. *Demonstrate and discuss proper GMAW safety procedures, applications, and the advantages and limitations of gas metal arc welding (GMAW), and identify the machine controls on a GMAW welder.*
   *a. Discuss safety procedures for GMAW tools, equipment, and applications.*
   *b. Discuss advantages and disadvantages of GMAW and demonstrate these findings.*
   *c. Demonstrate the use of machine controls and allow for student exploration.*

2. *Describe the short circuit transfer and spray arc metal transfer process, rules for GMAW electrode selection, uses of the common shielding gases in GMAW, and setup and shutdown of GMAW equipment.*
   a. *Discuss the short circuit transfer and spray arc process.*
   b. *Discuss electrode and gas selection for GMAW.*
   c. *Demonstrate setup and shutdown of GMAW equipment, and allow for student exploration.*
3. *Perform various welds in the flat position according to specifications.*
   a. *Demonstrate fabrication of various welded joints.*

***Suggested Assessment Strategies:***

1. *Demonstrate and discuss proper GMAW safety procedures, applications, and the advantages and limitations of gas metal arc welding (GMAW), and identify the machine controls on a GMAW welder.*
   a. *Unit test on safety procedures related to sheet GMAW tools, equipment, and procedures.*
   b. *Student Activity – Determine appropriate and inappropriate use of GMAW relative to application of use and environmental factors.*
   c. *Monitor student performing adjustment of controls on a GMAW welder.*
2. *Describe the short circuit transfer and spray arc metal transfer process, rules for GMAW electrode selection, uses of the common shielding gases in GMAW, and setup and shutdown of GMAW equipment.*
   a. *Test the student on identifying the different transfer methods of welding.*
   b. *Monitor the student on the appropriate selection of electrodes and gases for use in GMAW.*
   c. *Student activity – Allow for the student to choose appropriate electrodes and gases for practicing the transfer processes.*
3. *Perform various welds in the flat position according to specifications.*
   a. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

MAVCC. Gas Metal Arc Welding and Flux-Cored Arc Welding (GMAW/FCAW). Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1992.

**METAL TRADES II (Advanced Welding Option).**
**UNIT A3: FLUX CORE ARC WELDING (FCAW) (Optional)** **(15 days)**

**Competencies and Suggested Objectives:**

1. Demonstrate and describe proper safety practices required in FCAW, FCAW procedures, and major factors to consider when selecting FCAW electrodes.
   a. Demonstrate proper safety precautions required in FCAW including hand tools, power equipment, and personal safety.
   b. Describe FCAW procedures including dual-shield and self-shielding, and the major factors to consider when selecting FCAW electrodes including deposition rate, base metal, and shielding gas.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
2. Perform various welds in the flat position using FCAW techniques.
   a. Fabricate a multi-pass fillet weld and V-grooved butt joint weld in the flat and horizontal positions (vertical and overhead optional) using FCAW techniques according to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, M1, M4, M5, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP5, WP6*

***Suggested Teaching Strategies:***

1. *Demonstrate and describe proper safety practices required in FCAW, FCAW procedures, and major factors to consider when selecting FCAW electrodes.*
   *a. Demonstrate safety procedures for welding with FCAW tools and equipment.*
   *b. Discuss FCAW procedures for shielding and electrode selection.*
2. *Perform various welds in the flat position using FCAW techniques.*
   *a. Demonstrate fabrication of various welded joints.*

***Suggested Assessment Strategies:***

1. *Demonstrate and describe proper safety practices required in FCAW, FCAW procedures, and major factors to consider when selecting FCAW electrodes.*
   *a. Unit test on safety procedures related to FCAW equipment and procedures.*
   *b. Monitor the student on the appropriate selection of electrodes and gases for use in FCAW.*
2. *Perform various welds in the flat position using FCAW techniques.*
   *a. Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

MAVCC. Gas Metal Arc Welding and Flux-Cored Arc Welding (GMAW/FCAW). Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1992.

**METAL TRADES II (Advanced Welding Option)**
**UNIT A4: GAS TUNGSTEN ARC WELDING (GTAW) (Optional)** **(18 days)**

**Competencies and Suggested Objectives:**

1. Demonstrate and identify proper safety procedures, principles of GTAW, and setup of a GTAW welder.
   a. Demonstrate and describe proper safety precautions required in GTAW including hand tools, power equipment, and personal safety, and describe the principles of GTAW including heat generation, shielding gas, filler rod, and the different types of tungsten electrodes including color, finish, and application.
   b. Identify the major controls on a GTAW machine including the functions of each, the parts of a GTAW torch including the functions of each, and the different types of cups used on a GTAW torch including an application of each.
   c. Set up a GTAW welder including the adjustment of the flow meter regulator according to manufacturer's specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
2. Perform various welds in the flat position using proper GTAW techniques.
   a. Run stringer beads in the flat and horizontal positions (vertical and overhead optional).
   b. Fabricate a square grove butt weld and a T-joint fillet weld in the flat and horizontal positions (vertical and overhead optional).

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*

***Suggested Teaching Strategies:***

1. *Demonstrate and identify proper safety procedures, principles of GTAW, and setup of a GTAW welder.*
   a. *Demonstrate safety procedures for welding with GTAW tools and equipment.*
   b. *Discuss GTAW welding procedures, machine controls, and torch components including cups and electrodes.*
   c. *Demonstrate correct setup procedure and adjustment of controls on a GTAW welder.*
2. *Perform various welds in the flat position using proper GTAW techniques.*
   a. *Demonstrate proper technique for using GTAW.*
   b. *Demonstrate proper technique for using GTAW.*

***Suggested Assessment Strategies:***

1. *Demonstrate and identify proper safety procedures, principles of GTAW, and setup of a GTAW welder.*
   a. *Unit test on safety procedures related to GTAW equipment and procedures.*
   b. *Student activity - Determine correct application and use of machine control functions, settings, torch components, and cups.*
   c. *Monitor the student for correct setup procedure and adjustment of controls on a GTAW welder.*
2. *Perform various welds in the flat position using proper GTAW techniques.*
   a. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*
   b. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

MAVCC. Gas Tungsten Arc Welding and Plasma Arc Cutting. Stillwater, OK: Multistate Academic and Vocational Curriculum Consortium. 1992.

**METAL TRADES II (Advanced Welding Option)**
**UNIT A5: PLASMA ARC CUTTING (PAC)** **(2 days)**

**Competencies and Suggested Objectives:**

1. Set up and apply safety procedures in operation of the plasma arc cutter (PAC).
   a. Identify the major components of a PAC.
   b. Apply safety procedures in operation of the PAC.
   c. Adjust airflow and temperature settings.
   d. Operate a PAC to cut mild steel.
   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M1, S5*
   *Workplace Skills (See Appendix B): WP2, WP4*

***Suggested Teaching Strategies:***

*1. Set up and operate a plasma arc cutter (PAC).*
   *a. Demonstrate the major components of a PAC.*
   *b. Demonstrate safety procedures in operation of the PAC.*
   *c. Performance exercise to adjust airflow and temperature settings.*
   *d. Performance exercise to operate a PAC to cut mild steel.*

***Suggested Assessment Strategies:***

*1. Set up and operate a plasma arc cutter (PAC).*
   *a. Test - Identify the major components of a PAC.*
   *b. Performance Activity - Apply safety procedures in operation of the PAC.*
   *c. Performance Activity - Adjust airflow and temperature settings.*
   *d. Performance Activity - Operate a PAC to cut mild steel.*

**Suggested References:**

American Welding Society. Guide for the Training and Qualification of Welding Personnel: Entry Level Welder. Miami, FL: Author. 1995.

American Welding Society. Specification for Qualification and Certification for Entry Level Welders. Miami, FL: Author. 1995.

American Welding Society. Safety in Welding, Cutting, and Allied Processes (Z49.1.94). Miami, FL: Author. 1994.

American Welding Society. Welding Educator's Library. Miami, FL: Author. 1995.

MAVCC. Gas Tungsten Arc Welding and Plasma Arc Cutting. Stillwater, OK: Author. 1992.

# METAL TRADES II
## (Advanced Machine Shop Option)

**METAL TRADES II (Advanced Machine Shop Option)**
**UNIT B1: LATHE OPERATIONS** **(85 days)**

**Competencies and Suggested Objectives:**

1. Describe and identify safety precautions to be followed in using an engine lathe, methods for measuring thread pitch diameters, and calculation of dimensions using taper formulas.
   a. Describe safety precautions to be followed in using an engine lathe.
   b. Identify methods for measuring thread pitch diameters including micrometer and calipers.
   c. Calculate dimensions using taper formulas according to specifications.
   d. Obtain information from reference materials, such as the Machinist's Handbook.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
2. Perform various engine lathe operations according to specifications.
   a. Perform the following operations using an engine lathe: chamfer, recessing, knurling, drill and recess a hole, align and start a tap using a lathe center, and cutoff.
   b. Perform the following turning and cutting operations using an engine lathe: turn between centers; turn a taper with taper attachment, turn a taper with compound, boring, cut external threads to relief, pick up threads, and cut internal threads.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*

***Suggested Teaching Strategies:***

1. *Describe and identify safety procedures to be followed in using an engine lathe, methods for measuring thread pitch diameters, and calculation of dimensions using taper formulas.*
   *a. Demonstrate and identify proper safety procedures for engine lathe operation.*
   *b. Discuss methods of measuring by using micrometers and calipers.*
   *c. Demonstrate the calculation of dimensions through the use of formulas.*
   *d. Demonstrate how to obtain information from reference materials.*
2. *Perform various engine lathe operations according to specifications.*
   *a. Demonstrate correct setup procedure, adjustment, and performance of engine lathe operations.*
   *b. Demonstrate correct setup procedure, adjustment, and performance of engine lathe operations.*

***Suggested Assessment Strategies:***

1. *Describe and identify safety precautions to be followed in using an engine lathe, methods for measuring thread pitch diameters, and calculation of dimensions using taper formulas.*
   a. *Unit test on safety procedures related to engine lathe equipment and procedures.*
   b. *Student activity – Determine correct thread pitch diameter through use of appropriate measuring device.*
   c. *Test the student on applying formulas to find correct dimensions.*
   d. *Student activity - Obtain information from reference materials.*
2. *Perform various engine lathe operations according to specifications.*
   a. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*
   b. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

Dunn, J. Machine Shop Lathes. Stillwater, OK: Oklahoma Department of Vocational and Technical Education. 1982.

**METAL TRADES II (Advanced Machine Shop Option)**
**UNIT B2: MILLING OPERATIONS** **(35 days)**

**Competencies and Suggested Objectives:**

1. Describe and identify rules applying to milling machine safety; types of milling machines; major components of horizontal and vertical mills; work-holding devices, cutting tools, tool holders, and other attachments used with milling machines; and the different types of horizontal and vertical milling operations.
   a. Describe rules applying to milling machine safety including having safety guards in place, operating machines according to manufacturer's specifications, and wearing eye protection.
   b. Identify the types of milling machines including vertical and horizontal. Describe the major components of horizontal and vertical mills including base, head, table, saddle, and knee.
   c. Identify work-holding devices, cutting tools, tool holders, and other attachments used with milling machines including vises and holding clamps, end mill, and milling cutters.
   d. Describe the different types of horizontal milling operations including key cutting, spline cutting, angle cutting, and slotting, and the different types of vertical milling machine operations including key cutting, spline cutting, angle cutting, boring, drilling, and slotting.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
2. Adjust horizontal milling machine speed and feed rates, clean and lubricate a horizontal mill, mount arbors and adjust arbor support bushing on a horizontal milling machine, mount a cutter to a horizontal milling machine arbor, mill a keyway, and perform selected horizontal milling operations.
   a. Adjust machine speed and feed rates, and clean and lubricate a horizontal mill.
   b. Mount arbors and adjust arbor support bushing on a horizontal milling machine, and mount a cutter to a horizontal milling machine arbor according to specifications.
   c. Perform selected horizontal milling operations according to specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
3. Mount and remove cutters and cutter holders for vertical spindle milling machines, align a vise on a vertical milling machine using a dial indicator, and perform selected vertical milling and boring operations.
   a. Mount and remove cutters and cutter holders for vertical spindle milling machines, and mount and align a vise on a vertical milling machine.

b. Perform selected vertical milling and boring operations according to specifications.

*Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4*
*Workplace Skills (See Appendix B): WP2, WP4, WP5*

***Suggested Teaching Strategies:***

1. *Describe and identify rules applying to milling machine safety, types of milling machines, major components of horizontal and vertical mills, work-holding devices, cutting tools, tool holders, and other attachments used with milling machines, and the different types of horizontal and vertical milling operations.*
   a. *Demonstrate safety procedures to be followed when operating milling machines.*
   b. *Discuss the types of milling machines and the components of each.*
   c. *Discuss the features of work devices, tools, and attachments for milling machines.*
   d. *Discuss operations that can be performed by different types of milling machines.*
2. *Adjust horizontal milling machine speed and feed rates, clean and lubricate a horizontal mill, mount arbors and adjust arbor support bushing on a horizontal milling machine, mount a cutter to a horizontal milling machine arbor, mill a keyway, and perform selected horizontal milling operations.*
   a. *Demonstrate milling machine speed and feed rate adjustments, cleaning, and lubrication.*
   b. *Demonstrate arbor mounting, arbor support adjustment, and cutter mounting on a milling machine.*
   c. *Demonstrate milling operations.*
3. *Mount and remove cutters and cutter holders for vertical spindle milling machines, align a vise on a vertical milling machine using a dial indicator, and perform selected vertical milling and boring operations.*
   a. *Demonstrate mounting and removal of cutters and cutter holders; and demonstrate mounting and alignment of a vise.*
   b. *Demonstrate correct setup procedure, adjustment, and performance of milling and boring operations.*

***Suggested Assessment Strategies:***

1. *Describe and identify rules applying to milling machine safety; types of milling machines; major components of horizontal and vertical mills; work-holding devices, cutting tools, tool holders, and other attachments used with milling machines; and the different types of horizontal and vertical milling operations.*
   a. *Unit test on safety procedures related to milling machine equipment.*
   b. *Student activity – Determine the types of milling machines and components of each.*

   c. *Student activity – Determine appropriate use of work-holding devices, cutters, cutter holders, and attachments for milling machines.*
   d. *Test the student on identifying possible operations that can be performed with a milling machine.*
2. *Adjust horizontal milling machine speed and feed rates, clean and lubricate a horizontal mill, mount arbors and adjust arbor support bushing on a horizontal milling machine, mount a cutter to a horizontal milling machine arbor, mill a keyway, and perform selected horizontal milling operations.*
   a. *Monitor student for correct adjustment of speed and feed rates, and cleanliness of machine after operation.*
   b. *Monitor student for correct mounting of arbor, arbor bushing, and cutter.*
   c. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*
3. *Mount and remove cutters and cutter holders for vertical spindle milling machines, align a vise on a vertical milling machine using a dial indicator, and perform selected vertical milling and boring operations.*
   a. *Monitor student for correct mounting of cutter and cutter holders; and for mounting and alignment of vise.*
   b. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

Dunn, J. Machine Shop Milling Machines. Stillwater, OK: Oklahoma Department of Vocational and Technical Education. 1983.

**METAL TRADES II (Advanced Machine Shop Option)**
**UNIT B3: GRINDING OPERATIONS** **(15 days)**

**Competencies and Suggested Objectives:**

1. Describe safety procedures for grinding machine safety, magnetic chuck work, surface grinding operations, and reasons for truing and balancing a grinding wheel.
   a. Describe rules for grinding machine safety including standing to the right front side of the machine when in operation, having safety guards in place, conducting ring test when installing new grinding wheel, operating according to manufacturer's specifications, and wearing protective equipment.
   b. Describe safety rules that apply to magnetic chuck work including cleaning, deburring, and operating according to manufacturer's specifications.
   c. Identify surface grinding operations including grinding flat surfaces, edges, cut-off, slots, and angle surfaces.
   d. Explain reasons for truing and balancing grinding wheels including making wheel concentric, eliminating chatter marks, eliminating vibration, and removing glazing.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*
2. Perform maintenance operations on a bench grinder to manufacturer's specifications and grinding operations to teacher's specifications.
   a. Remove and replace a grinding wheel on a grinding machine according to manufacturer's specifications.
   b. Dress a grinding machine wheel flat according to manufacturer's specifications.
   c. Grind a workpiece flat and parallel according to manufacturer's specifications. Grind a workpiece square, an angular surface, and to dimension according to teacher's specifications.

   *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4*
   *Workplace Skills (See Appendix B): WP2, WP4, WP5*

***Suggested Teaching Strategies:***

1. *Describe safety procedures for grinding machine safety, magnetic chuck work, surface grinding operations, and reasons for truing and balancing a grinding wheel.*
   a. *Demonstrate safety procedures to be followed when operating grinding machines.*
   b. *Demonstrate safety procedures to be followed when doing magnetic chuck work.*

c. *Discuss the surface grinder operations.*
d. *Demonstrate procedures for maintenance of grinding wheels.*

2. *Perform maintenance operations on a bench grinder to manufacturer's specifications and grinding operations to teacher's specifications.*
   a. *Demonstrate procedures for removal and replacement of grinding wheels.*
   b. *Demonstrate procedure for dressing a grinding wheel.*
   c. *Demonstrate procedure for grinding a workpiece to dimension.*

***Suggested Assessment Strategies:***

1. *Describe safety procedures for grinding machine safety, magnetic chuck work, surface grinding operations, and reasons for truing and balancing a grinding wheel.*
   a. *Unit test on safety procedures related to grinding machine equipment.*
   b. *Unit test on safety procedures related to magnetic chuck work.*
   c. *Student Activity – Determine appropriate grinding operations in relation to an assigned task and perform grinding.*
   d. *Student Activity – Identify procedures that will correct grinding wheel imperfections and alignment problems and perform corrections.*
2. *Perform maintenance operations on a bench grinder to manufacturer's specifications and grinding operations to teacher's specifications.*
   a. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*
   b. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*
   c. *Project test – Complete project to acceptable specifications through proper selection and use of tools and materials.*

**Suggested References:**

Dunn, J. Machine Shop Grinding Machines. Stillwater, OK: Oklahoma Department of Vocational and Technical Education. 1983.

# SECTION III:

# RECOMMENDED TOOLS AND EQUIPMENT

# RECOMMENDED TOOLS AND EQUIPMENT FOR METAL TRADES

(Amounts are given per program.)

## WELDING

1. First aid kit (1 each)
2. Emergency eye wash station (1 each)
3. Work bench with medium duty vise (4 each)
4. 8" c-clamps (1 set)
5. 4½" right angle grinder (1 each)
6. 9" right angle grinder (1 each)
7. Oxyfuel burning table with dross pan and replaceable slats (4'x8'x31") (2 each)
8. Work area protective screens (as required) (1 each)
9. Exhaust system (1 each)
10. Guided bend testjig or machine (1 each)
11. Framing squares (24"x18") (6 each)
12. Compressed air supply and accessories (min. delivery 80 psi @ 8 cfm per station) (1 each)
13. Compressed air hose (50") with retractable reel (2 each)
14. Compressed air regulator (1 each)
15. Male and female quick couples and adaptors (1 each)
16. Hose repair kit with crimping tool for OAC (1 each)
17. Plasma arc cutting device with min. ½" cutting depth (1 each)
18. Shielded metal arc welding machines (AC/DC - constant current 300 amp @ 60%) with cables and accessories (6 each)
19. Gas tungsten arc welding machine (AC/DC - constant current 300 amp @ 60%) with cables and accessories (1 each)
20. Gas metal arc welding machine (spray and short circuit) (DC - constant voltage 300 amp @ 100%) with cables, gun, and accessories (2 each)
21. Flux cored arc welding machine (DC - constant voltage 300 amp @ 100%) with cables, gun, and accessories (1 each)
22. Oxyfuel gas cutting equipment with regulators, hoses, torch, tips, cart, and accessories (2 sets)
23. Machine oxyfuel gas cutting equipment with regulators, hoses, torch, tips, rails or track, and accessories (1 set)
24. Leather jacket, cape, sleeves or apron (6 sets)
25. Leather gloves (new program) (6 sets)
26. Safety glasses with side shields and a sanitizing cabinet (2 sets)
27. Burning goggles or face shield (5 each)
28. #5 filter plate/lens (2 each)
29. Clear cover plate/lens (4 each)
30. Welding helmet (10 each)
31. Welding lenses to match helmet, #10 shaded filter plate/lens (2 each)

32. Clear cover plate/lens (4 each)
33. Stainless steel wire brush (1 for every 2 students) (10 each)
34. 16 ounce ball peen hammer (4 each)
35. Electric hand drill (¼", ⅜", ½" chuck) (1 each)
36. Center punches (1 set)
37. Metal scribe (6 each)
38. Steel dividers (radius maker, min. 6") (2 each)
39. Steel tape measure (minimum 10') (4 each)
40. Combination square set (4 each)
41. English/metric steel bench rule (min. 12") (6 each)
42. Chipping hammer (6 each)
43. 10" mill file (half round-bastard cut) (6 each)
44. Cold chisels (1 set)
45. Adjustable wrenches (12", 10", 8", 6") (1 set)
46. Tank wrench (2 each)
47. 10" groove or slip joint pliers (8 each)
48. 6" side or diagonal cutting pliers (4 each)
49. 6" needle nose pliers (2 each)
50. 10" vise grips (4 each)
51. 10" vise grip clamp (4 each)
52. Allen or hex wrenches (to ⅜") (1 set)
53. Screwdrivers flat head (1 set)
54. Screwdrivers phillips head (1 set)
55. Oxyfuel friction lighter, with flints and tip cleaners (4 each)
56. Fillet gages (1 set)
57. Ironworker (1 each)
58. Pedestal gringer (2 each)
59. Large drill press (1 each)
60. Small drill press (1 each)
61. Band saw (1 each)
62. Saw, power cutoff (1)
63. Vise grip, welding clamps (6)
64. Clamp, C, set (4"-12") (2)

MACHINE SHOP

1. Lathes w/accessories (14") (4 each)
2. Vertical milling machine with vise (3 each)
3. Horizontal milling machine with vise (1 each)
4. Surface grinder (2 each)
5. Horizontal bandsaw (1 each)
6. Vertical bandsaw (1 each)
7. Hydraulic press (min. 25 ton) (1 each)
8. Dividing head with tailstock (1 each)
9. Rotary table for milling machine (1 each)

10. Gage blocks (1 set)
11. Tap and die, English set (include most common sizes in taper, plug, and bottom in NC and NF) (2)
12. Micrometers (0"- 6") (1 set)
13. Micrometers (0"- 1") (4 each)
14. Dial indicator with magnetic base (graduated for .001", range ½") (2)
15. Depth micrometer (0"-6") (1 each)
16. Angle blocks (4", 6") (1 each)
17. Thread pitch gage (1 each)
18. Dial caliper (8") (1 each)
19. Vernier caliper (8") (1 each)
20. Thread micrometer (0"-2") (1 each)
21. Height gage (1 each)
22. Surface plate gage (1 each)
23. Machinist rules (6") (6 each)
24. Gage, center and edge combination (6)
25. Hook rule (6") (1 each)
26. Edge finder (1 each)
27. Hole punches (1 set)
28. Drill bits (numbers, letters, fractions) (1 set)
29. Transfer punches (1 set)
30. V blocks (1 set)
31. Machinist's level (1 each)
32. Parallels (1" to ⅜") (1 set)
33. Tap and die, metric set (include most common sizes in taper plug and bottom) (2)
34. Sander, belt (1)
35. Oil can (8)
36. Reamer, tapered, set (5/8" - 1") (1)
37. Reamer, adjustable (6)
38. Reamer, shell, set (1)
39. Sander, disk (1)
40. Drill, taper, set (5/8" - 1") (1)
41. Scale, 12" (6)
42. Vise grip (6)
43. Wrench, pipe, set (6", 10" & 12") (1)
44. Hammer, ball peen set (small, medium, and large) (4)
45. Hammer, sledge (10 lb) (1)
46. Drill press and mill tools (2)
47. Set, counter (6)
48. Caliper, inside (6)
49. Caliper, outside (6)
50. Micrometer, digital (2)
51. Caliper, digital (2)

SHEET METAL

1. Aviation snips (left, right, straight) (3 sets)
2. Straight snips (2 each)
3. Combination snips (2 each)
4. Bulldog snips (2 each)
5. Scratch awl (6 each)
6. Circumference rule (4 each)
7. Dividers (6"- 12") (1 each)
8. Trammel points (1 set)
9. Rivet hammer (4 each)
10. Tiner's hammer (4 each)
11. Soft face mallet (wood, rawhide, rubber) (1 each)
12. Rivet setter (1 each)
13. Hand groove set (3/16"- ½") (1 each)
14. Hand seamer (1 each)
15. Dove tailer (1 each)
16. Soldering copper (flat) (1 each)
17. Soldering copper (diamond) (1 each)
18. Whitney punch (1 each)
19. Pop rivet gun (2 each)
20. E-Z edger (1 each)
21. 4' box and pan brake with bar folder (1 each)
22. 4' shear with 16 gage capability (1 each)
23. Crimping machine (1 each)
24. Slip roll former (1 each)
25. Sheet metal set down tools, stake set, and table (1)

# APPENDIX A:

# RELATED ACADEMIC TOPICS

# APPENDIX A

## RELATED ACADEMIC TOPICS FOR COMMUNICATIONS

C1 Interpret written material.
C2 Interpret visual materials (maps, charts, graphs, tables, etc.).
C3 Listen, comprehend, and take appropriate actions.
C4 Access, organize, and evaluate information.
C5 Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.
C6 Communicate ideas and information effectively using various oral and written forms for a variety of audiences and purposes.

## EXPANDED TOPICS FOR COMMUNICATIONS

### TOPIC C1: Interpret written material.

C1.01 Read and follow complex written directions.
C1.02 Recognize common words and meanings associated with a variety of occupations.
C1.03 Adjust reading strategy to purpose and type of reading.
C1.04 Use sections of books and reference sources to obtain information.
C1.05 Compare information from multiple sources and check validity.
C1.06 Interpret items and abbreviations used in multiple forms.
C1.07 Interpret short notes, memos, and letters.
C1.08 Comprehend technical words and concepts.
C1.09 Use various reading techniques depending on purpose for reading.
C1.10 Find, read, understand, and use information from printed matter or electronic sources.

### TOPIC C2: Interpret visual materials (maps, charts, graphs, tables, etc.).

C2.01 Use visuals in written and in oral presentations.
C2.02 Recognize visual cues to meaning (layout, typography, etc.).
C2.03 Interpret and apply information using visual materials.

### TOPIC C3: Listen, comprehend, and take appropriate action.

C3.01 Identify and evaluate orally-presented messages according to purpose.
C3.02 Recognize barriers to effective listening.
C3.03 Recognize how voice inflection changes meaning.
C3.04 Identify speaker signals requiring a response and respond accordingly.
C3.05 Listen attentively and take accurate notes.
C3.06 Use telephone to receive information.

C3.07 Analyze and distinguish information from formal and informal oral presentations.

TOPIC C4: Access, organize, and evaluate information.

C4.01 Distinguish fact from opinion.
C4.02 Use various print and non-print sources for specialized information.
C4.03 Interpret and distinguish between literal and figurative meaning.
C4.04 Interpret written or oral communication in relation to context and writer's point of view.
C4.05 Use relevant sources to gather information for written or oral communication.

TOPIC C5: Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.

C5.01 Select appropriate words for communication needs.
C5.02 Use reading, writing, listening, and speaking skills to solve problems.
C5.03 Compose inquiries and requests.
C5.04 Write persuasive letters and memos.
C5.05 Edit written reports, letters, memos, and short notes for clarity, correct grammar, and effective sentences.
C5.06 Write logical and understandable statements, phrases, or sentences for filling out forms, for correspondence or reports.
C5.07 Write directions or summaries of processes, mechanisms, events, or concepts.
C5.08 Select and use appropriate formats for presenting reports.
C5.09 Convey information to audiences in writing.
C5.10 Compose technical reports and correspondence that meet accepted standards for written communications.

TOPIC C6: Communicate ideas and information using oral and written forms for a variety of audiences and purposes.

C6.01 Give complex oral instructions.
C6.02 Describe a business or industrial process/mechanism.
C6.03 Participate effectively in group discussions and decision making.
C6.04 Produce effective oral messages utilizing different media.
C6.05 Explore ideas orally with partners.
C6.06 Participate in conversations by volunteering information when appropriate and asking relevant questions when appropriate.
C6.07 Restate or paraphrase a conversation to confirm one's own understanding.
C6.08 Gather and provide information utilizing different media.

C6.09 Prepare and deliver persuasive, descriptive, and demonstrative oral presentations.

**RELATED ACADEMIC TOPICS FOR MATHEMATICS**

M1 Relate number relationships, number systems, and number theory.
M2 Explore patterns and functions.
M3 Explore algebraic concepts and processes.
M4 Explore the concepts of measurement.
M5 Explore the geometry of one-, two-, and three-dimensions.
M6 Explore concepts of statistics and probability in real world situations.
M7 Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

EXPANDED TOPICS FOR MATHEMATICS

TOPIC M1: Relate number relationships, number systems, and number theory.

M1.01 Understand, represent, and use numbers in a variety of equivalent forms (integer, fraction, decimal, percent, exponential, and scientific notation) in real world and mathematical problem situations.
M1.02 Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.
M1.03 Understand and apply ratios, proportions, and percents in a wide variety of situations.
M1.04 Investigate relationships among fractions, decimals, and percents.
M1.05 Compute with whole numbers, fractions, decimals, integers, and rational numbers.
M1.06 Develop, analyze, and explain procedures for computation and techniques for estimations.
M1.07 Select and use an appropriate method for computing from among mental arithmetic, paper-and-pencil, calculator, and computer methods.
M1.08 Use computation, estimation, and proportions to solve problems.
M1.09 Use estimation to check the reasonableness of results.

TOPIC M2: Explore patterns and functions.

M2.01 Describe, extend, analyze, and create a wide variety of patterns.
M2.02 Describe and represent relationships with tables, graphs, and rules.
M2.03 Analyze functional relationships to explain how a change in one quantity results in a change in another.
M2.04 Use patterns and functions to represent and solve problems.
M2.05 Explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations.

M2.06 Use a mathematical idea to further their understanding of other mathematical ideas.
M2.07 Apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, and business.

TOPIC M3: Explore algebraic concepts and processes.

M3.01 Represent situations and explore the interrelationships of number patterns with tables, graphs, verbal rules, and equations.
M3.02 Analyze tables and graphs to identify properties and relationships and to interpret expressions and equations.
M3.03 Apply algebraic methods to solve a variety of real world and mathematical problems.

TOPIC M4: Explore the concepts of measurement.

M4.01 Estimate, make, and use measurements to describe and compare phenomena.
M4.02 Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.
M4.03 Extend understanding of the concepts of perimeter, area, volume, angle measure, capacity, and weight and mass.
M4.04 Understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs.

TOPIC M5: Explore the geometry of one-, two-, and three-dimensions.

M5.01 Identify, describe, compare, and classify geometric figures.
M5.02 Visualize and represent geometric figures with special attention to developing spatial sense.
M5.03 Explore transformations of geometric figures.
M5.04 Understand and apply geometric properties and relationships.
M5.05 Classify figures in terms of congruence and similarity and apply these relationships.

TOPIC M6: Explore the concepts of statistics and probability in real world situations.

M6.01 Systematically collect, organize, and describe data.
M6.02 Construct, read, and interpret tables, charts, and graphs.
M6.03 Develop an appreciation for statistical methods as powerful means for decision making.
M6.04 Make predictions that are based on exponential or theoretical probabilities.

M6.05 Develop an appreciation for the pervasive use of probability in the real world.

TOPIC M7: Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

M7.01 Use computers and/or calculators to process information for all mathematical situations.
M7.02 Use problem-solving approaches to investigate and understand mathematical content.
M7.03 Formulate problems from situations within and outside mathematics.
M7.04 Generalize solutions and strategies to new problem situations.

**RELATED ACADEMIC TOPICS FOR SCIENCE**

S1 Explain the Anatomy and Physiology of the human body.
S2 Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.
S3 Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.
S4 Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.
S5 Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.
S6 Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.
S7 Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance, population genetics, the structure and function of DNA, and current applications of DNA technology.
S8 Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

EXPANDED TOPICS FOR SCIENCE

TOPIC S1: Explain the Anatomy and Physiology of the human body.

S1.01 Recognize common terminology and meanings.
S1.02 Explore the relationship of the cell to more complex systems within the body.

S1.03 Summarize the functional anatomy of all the major body systems.
S1.04 Relate the physiology of the major body systems to its corresponding anatomy.
S1.05 Compare and contrast disease transmission and treatment within each organ system.
S1.06 Explore the usage of medical technology as related to human organs and organ systems.
S1.07 Explain the chemical composition of body tissue.

TOPIC S2: Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.

S2.01 Identify the major types and structures of plants, viruses, monera, algae protista, and fungi.
S2.02 Explain sexual and asexual reproduction.
S2.03 Describe the ecological importance of plants as related to the environment.
S2.04 Analyze the physical chemical and behavioral process of a plant.

TOPIC S3: Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.

S3.01 Explain the morphology, anatomy, and physiology of animals.
S3.02 Describe the characteristics, behaviors, and habitats of selected animals.

TOPIC S4: Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.

S4.01 Examine minerals and their identification, products of the rock cycle, byproducts of weathering, and the effects of erosion.
S4.02 Relate the Hydrologic Cycle to include groundwater its zones, movement, and composition; surface water systems, deposits, and runoff.
S4.03 Consider the effects of weather and climate on the environment.
S4.04 Examine the composition of seawater; wave, tides, and currents; organisms, environment, and production of food; energy, food and mineral resources of the oceans.

TOPIC S5: Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.

S5.01 Examine the science of chemistry to include the nature of matter, symbols, formulas and nomenclature, and chemical equations.

S5.02 Identify chemical reactions including precipitation, acids-bases, and reduction-oxidation.
S5.03 Explore the fundamentals of chemical bonding and principles of equilibrium.
S5.04 Relate the behavior of gases.
S5.05 Investigate the structure, reactions, and uses of organic compounds; and investigate nuclear chemistry and radiochemistry.

TOPIC S6: Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.

S6.01 Examine fundamentals of motion of physical bodies and physical dynamics.
S6.02 Explore the concepts and relationships among work, power, and energy.
S6.03 Explore principles, characteristics, and properties of electricity, magnetism, light energy, thermal energy, and wave energy.
S6.04 Identify principles of modern physics related to nuclear physics.

TOPIC S7: Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance; population genetics, the structure and function of DNA, and current applications of DNA technology.

S7.01 Examine principles, techniques, and patterns of traits and inheritance in organisms.
S7.02 Apply the concept of population genetics to both microbial and multicellular organism.
S7.03 Identify the structure and function of DNA and the uses of DNA technology in science, industry, and society.

TOPIC S8: Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

S8.01 Apply the components of scientific processes and methods in classroom and laboratory investigations.
S8.02 Observe and practice safe procedures in the classroom and laboratory.
S8.03 Demonstrate proper use and care for scientific equipment.
S8.04 Investigate science careers, and advances in technology.
S8.05 Communicate results of scientific investigations in oral, written, and graphic form.

# APPENDIX B:

# WORKPLACE SKILLS

# APPENDIX B
# WORKPLACE SKILLS FOR THE 21ST CENTURY

WP1 Allocates resources (time, money, materials and facilities, and human resources).

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.

WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.

WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.

WP5 Selects, applies, and maintains/troubleshoots technology.

WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.

# APPENDIX C:

# STUDENT COMPETENCY PROFILE

# STUDENT COMPETENCY PROFILE FOR METAL TRADES I

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each course. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the program.

In the blank before each competency, place the date on which the student mastered the competency.

## Unit 1: Orientation and Safety

_____ 1. Demonstrate the student school handbook and classroom policies.
_____ 2. Review occupational and leadership opportunities in metal trades.
_____ 3. Demonstrate safety procedures used in metal trades.
_____ 4. Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.

## Unit 2: Measurement, Inspections, and Blueprints

_____ 1. Calculate measurements using fractions and decimals.
_____ 2. Inspect a machined part as per specifications with various instruments.
_____ 3. Interpret blueprint symbols, abbreviations, alphabet of lines, types of views, and title blocks.

## Unit 3: Bench Work

_____ 1. Identify and describe hand tools and their safe use.
_____ 2. Lay out and fabricate a given project using the combination square.

## Unit 4: Power Saws and Drilling Machines

_____ 1. Identify and describe the safe operation of the types of power saws to include care, cleaning, use, and performance of cutting operations.
_____ 2. Identify and describe the types of drilling machines, hand powered and drill press, and the rules for safe operation of each.

## Unit 5: Basic Oxyacetylene Welding, Cutting and Brazing

_____ 1. Identify and describe the basic equipment, setup, and safety rules for proper use of oxyacetylene equipment.

_____ 2. Perform welding, cutting, and brazing operations with oxyacetylene equipment.

Unit 6: Basic Shielded Arc Metal Welding

_____ 1. Identify and describe procedures and processes for SMAW.
_____ 2. Demonstrate proper striking and restriking of an electrode, controlling the crater, backfilling a bead, and building a pad.

Unit 7: Basic Machine Shop

_____ 1. Identify and describe safety rules that apply to the pedestal grinder, and perform inspection, maintenance, and grinding operations.
_____ 2. Identify and compare shapes of single-point, carbide, and high speed steel cutting tools. Perform a free-hand grinding of a turning tool, facing tool, and a 60-degree threading tool.
_____ 3. Identify safety rules and components of an engine lathe, to include use of accessories, care and cleaning, basic operations, lathe speeds, and feeds.
_____ 4. Remove and install a lathe chuck, and perform lathe operations.

Unit 8: Basic Sheet Metal Repair

_____ 1. Identify and describe hand tools, sheet metal machines, and terms used in sheet metal work.
_____ 2. Fabricate sheet metal projects as assigned, using various hand tools and sheet metal machines.

# STUDENT COMPETENCY PROFILE
# FOR METAL TRADES II (Advanced Welding Option)

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each course. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the program.

In the blank before each competency, place the date on which the student mastered the competency.

## Unit A1: Shielded Metal Arc Welding (SMAW)

_____ 1. Demonstrate proper safety practices and welding techniques for SMAW.

## Unit A2: Gas Metal Arc Welding (GMAW)

_____ 1. Demonstrate and discuss proper GMAW safety procedures, applications, and the advantages and limitations of gas metal arc welding (GMAW), and identify the machine controls on a GMAW welder.

_____ 2. Describe the short circuit transfer and spray arc metal transfer process, rules for GMAW electrode selection, uses of the common shielding gases in GMAW, and setup and shutdown of GMAW equipment.

_____ 3. Perform various welds in the flat position according to specifications.

## Unit A3: Flux Core Arc Welding (FCAW) (Optional)

_____ 1. Demonstrate and describe proper safety practices required in FCAW, FCAW procedures, and major factors to consider when selecting FCAW electrodes.

_____ 2. Perform various welds in the flat position using FCAW techniques.

## Unit A4: Gas Tungsten Arc Welding (GTAW) (Optional)

_____ 1. Demonstrate and identify proper safety procedures, principles of GTAW, and setup of a GTAW welder.

_____ 2. Perform various welds in the flat position using proper GTAW techniques.

## Unit A5: Plasma Arc Cutting (PAC)

_____ 1. Set up and apply safety procedures in operation of the plasma arc cutter (PAC).

# STUDENT COMPETENCY PROFILE
# FOR METAL TRADES II (Advanced Machine Shop Option)

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each course. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the program.

In the blank before each competency, place the date on which the student mastered the competency.

## Unit B1: Lathe Operations

_____ 1. Describe and identify safety precautions to be followed in using an engine lathe, methods for measuring thread pitch diameters, and calculation of dimensions using taper formulas.

_____ 2. Perform various engine lathe operations according to specifications.

## Unit B2: Milling Operations

_____ 1. Describe and identify rules applying to milling machine safety; types of milling machines; major components of horizontal and vertical mills; work-holding devices, cutting tools, tool holders, and other attachments used with milling machines; and the different types of horizontal and vertical milling operations.

_____ 2. Adjust horizontal milling machine speed and feed rates, clean and lubricate a horizontal mill, mount arbors and adjust arbor support bushing on a horizontal milling machine, mount a cutter to a horizontal milling machine arbor, mill a keyway, and perform selected horizontal milling operations.

_____ 3. Mount and remove cutters and cutter holders for vertical spindle milling machines, align a vise on a vertical milling machine using a dial indicator, and perform selected vertical milling and boring operations.

## Unit B3: Grinding Operations

_____ 1. Describe safety procedures for grinding machine safety, magnetic chuck work, surface grinding operations, and reasons for truing and balancing a grinding wheel.

_____ 2. Perform maintenance operations on a bench grinder to manufacturer's specifications and grinding operations to teacher's specifications.